Mechanical World

AND ENGINEERING RECORD

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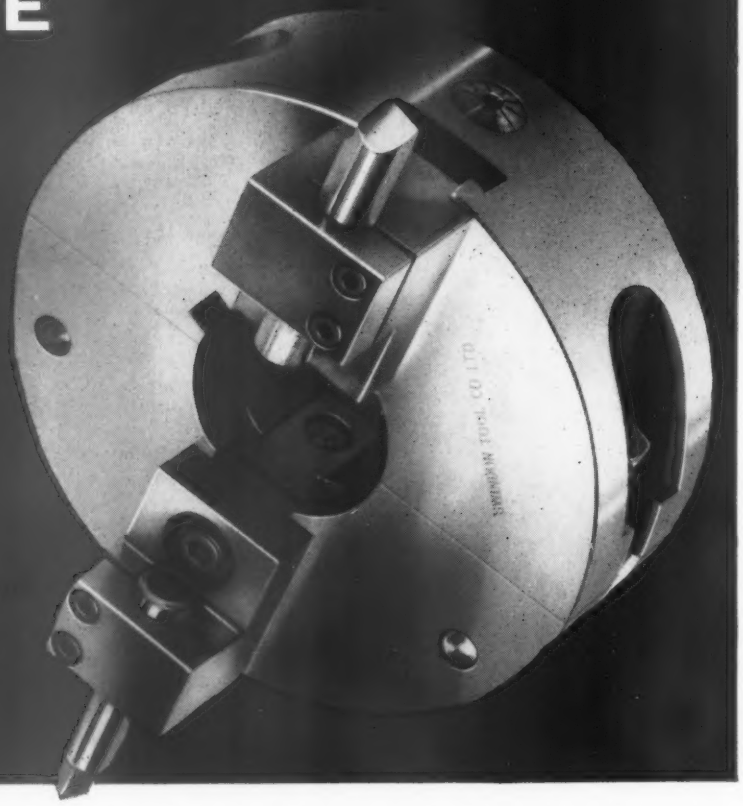
Announcing

ANOTHER SWINTOOL WINNER!

THE NEW BAR TYPE BORING HEAD



Here is the latest addition to the Swintool range of precision machine tools, the new Bar Type Boring Head, with micrometer adjustment. The illustration clearly demonstrates the simplicity of adjustment, plus rigid clamping, which are features exclusive to this new machine tool. Full details and specification will be sent on request.

SWINTOOL

World patents applied for

BAR TYPE BORING HEAD

SEND TODAY FOR ILLUSTRATED BROCHURE

SWINDON TOOL COMPANY LIMITED

INDUSTRIAL ESTATE, CHENEY MANOR, SWINDON, WILTSHIRE

ENQUIRIES FROM THE TRADE INVITED

Mechanical World —— July 1959

The Helpful Manufacturer

TO increase productivity and thereby cheapen the product is a good reason for buying new machinery. The decision to do this is clear cut in the case of a manufacturing process where old machinery is in use and when greatly improved machinery is available. At the present time the new machinery will cost a lot more than did the old when it was new, in the first place because materials and labour cost more, and secondly because the new machinery will gain its high performance from a refinement and elaboration absent in the earlier design. Though costing perhaps several times as much, it will certainly process more product and require less manual attention. Consider for a moment the case of no change in product cost and 10 years life for the new machine. Manual attention costs less per year, and the difference can be the equivalent of something approaching 10% of the cost of the new machine. Thus if the saving in manual attention amounted to £1000 a year (a figure so modest that it will apply almost anywhere) then the machine could cost about £10,000 without the cost of the product being altered. If it costs less then the product will be cheaper.

All this sounds simple, but in running a business there are so many incompatible factors that the general complexity overlays the simplicity of the separate aspects. Circumstances vary from time to time and a budget of capital expenditure made in the optimism of an expanding market does not look so attractive when the order book is running well below deliveries.

A closer look into plans which engender this contrast will often show that they are designed for improvement generally and not for a definite cost objective. It is easy to shelve the first kind for their absence will not be missed for a year or so, but neglecting the latter means that as time goes on the product is going to cost more and more. Provided there is a market at all it pays to cater for it with increasing efficiency.

This can be done by keeping track of new machinery all the time, not just noting what is available but finding out exactly what it will do, what it will cost to instal and operate, and how the product cost will be affected.

If there is any clear evidence that the product cost at the current rate of output can be reduced, then money can be saved, even in difficult times, by installing the new plant.

Industries with big producing units have this matter of policy making well organized: the two go together. They are so large that nobody has two jobs and every job requires a team, so keeping track of the possibilities of cost reduction is work for a team of specialists and since their jobs depend upon it they do it well. In smaller plants somebody has to do it now and then, and unless interest in it is keen it is not likely to be done well. Fortunately anyone can have the work done for him all the time these days. The suppliers know the subject as well as anybody and better than most, and set themselves out to provide it all the time for their friends and customers. It is a service worth using.

LOG SHEET

Selling the "Know How"

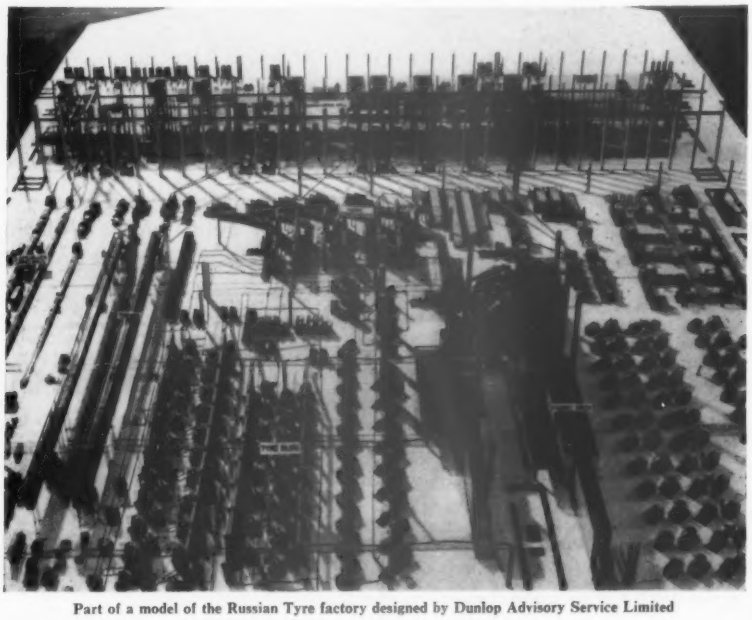
The Dunlop Rubber Company Limited, by reason of its experience in establishing factories in many parts of the world, and particularly over the last 25 years, has a wide fund of knowledge to draw upon relating to initial surveys and the resultant construction of factory buildings, engineering services, and manufacturing equipment. This knowledge has until recently been available only for Dunlop's use, and it was a new venture for the company to undertake consultancy work for outside concerns through a separate company, Dunlop Advisory Service Limited. At the present time the company is mainly engaged as consultants to a consortium of British companies operating under the name of Rustyfa Limited, and the work that it has already provided in the way of initial and final surveys with visits of their representatives to Moscow and technical discussions over here with Russian representatives has made possible the sale from Britain of approximately £14,000,000 worth of engineering service plant and rubber and tyre manufacturing machinery for a new factory being erected in the U.S.S.R. at Dneipropetrovsk, which may become one of the largest tyre production units under one roof in the world.

Russian Tyre Plant

At the 79 acre Dneipropetrovsk site, power is brought to the site by overhead transmission lines at 154,000 volts and is transformed to 6000 volts through two 31,500 kVA transformers, and steam is piped from an adjacent power station; the total steam consumption used will be some 180,000 lb/hr. Process cooling water will be obtained from local storage originating from the Dneiper River. There will be three cooling circuits fed under pressure from a central pumping station at approximately 2000 gpm.

The manufacturing building is approximately 1170 ft long × 570 ft wide with a 3-storey section at the West end giving a total floor area of 765,000 sq ft, or 17½ acres. The mill room section housing the automatic powder handling system occupies ground, first and second floors, the remainder of the building being varied in height in relation to the demands of the various processes. All the buildings are of pre-cast, reinforced concrete construction.

A separate building accommodates stocks of raw materials at one end and the finished goods at the other. Concrete silos provide for the reception and storage of the various carbon blacks.



Part of a model of the Russian Tyre factory designed by Dunlop Advisory Service Limited

Carbon black from the storage silos together with other powders are discharged into hoppers above the large Banbury mixers. Oils are piped to the mixers and these together with the powders are automatically weighed to formulae interpreted by punched cards inserted into card readers.

An overhead system conveys the bales of rubber from the store into the mill room. In cold weather frozen bales will be automatically passed through di-electrically heated ovens to thaw them and bring them to processing temperature.

The various grades of rubber are pelletized and mixed in the correct sequence as determined by the card system.

A series of strip conveyors deliver the hot, mixed rubber from roller mills for distribution to the calender tread or tube extruders, and two large fabric dipping, drying, tensioning units are arranged in line with the rubber calenders, the whole system being automatically controlled.

The rolls of fabric are conveyed to the bias cutters, after which they are continuously joined and arranged in storage conveyors for distribution to the various tyre building machines. The treads, with the exception of the very large sizes, are also conveyed automatically on arrival at the tyre building machines according to demand.

The uncured tyres are automatically delivered to the inspection point, following which it is painted and automatically picked up for delivery to the vulcanizers.

Vulcanizing is done in 242 Bag-O-Matic presses. The whole operation of discharging from the feed conveyors to the press, together with the operations prior to closing the press, are all automatically controlled by electrically driven timing apparatus. The timers also control the supply of steam, hot water and other services to the diaphragm within the press. After vulcanizing and the reversal of the services within the diaphragm, the press is automatically opened and the tyre ejected and conveyed to the finishing section.

A control system is being provided which will automatically report the production of the various codes of mixings, types of fabric, tyres and tubes produced, to the production control room where the printers punch out the required information on to tape feeding the automatic typewriters which record the produc-

tion figures each hour and give the totals of such production at the end of each shift.

Record Coal Shifting

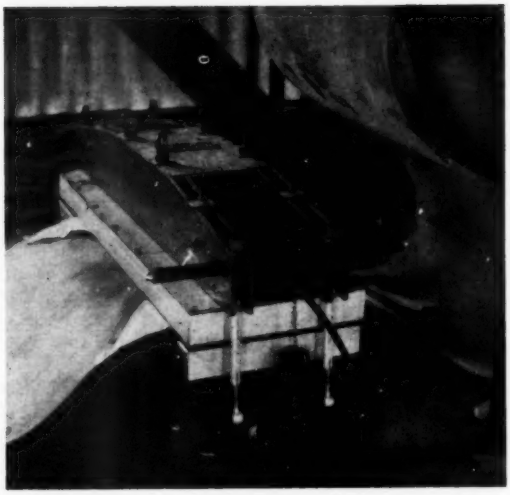
One of the worst problems at any coal-fired generating station is the stock-piling of its coal. Reserves, which of necessity must be kept at a high level, must also be kept stacked compactly, particularly in industrial areas where available space is limited; this makes doubly important the need for rapid, efficient mechanical reclamation and movement of reserves. There is also another important reason for compacting the coal—the hazard of spontaneous combustion.

To meet this special need, the Marshall Organization has introduced a specially developed 'U' construction coal handling blade matched to the new Fowler Challenger 33 crawler tractor, and during a timed trial at Hams Hall Power Station, Birmingham, a Challenger fitted with the new blade achieved the record overall figure of 412 tons per hour, moving pulverized coal from stockpile to conveyor hopper. The figure was reached in a series of tests, each using a different operating technique.

Starting with a flat compacted deck, the machine developed load evenly over a distance of 200 ft to the hopper and left a flat bottomed trench the width of the blade at the conclusion of the tests. Average cycle time over the whole test for a 400 ft trip was 1 min 39 sec. Average push stroke was 71 sec, average return stroke 27 sec, and average load per push 10·9 tons.

Titanium Electrodes

Titanium's outstanding resistance to corrosion makes it particularly suitable for equipment in constant contact with many aggressive chemicals and liquors. For a long time there has been a growing demand for an economic non-consumable electrode for a wide range of electrochemical processes. By coating a titanium electrode with a thin layer of platinum which need not be continuous, I.C.I. Metals Division have produced an electrode which is light yet robust and which will operate without deterioration for long periods in many liquids at very high anodic current densities. The cathodic protection of a steel pier immersed in seawater is one application.



SPLICING A CONVEYOR BELT.—This Goodyear Style B conveyor belt is shown at the beginning of the curing of a splice at the Priolo installation in Sicily of the S.I.N.C.A.T. organization's fertilizer plant. The belt is reinforced rayon 31½ in. × 5 ply at 1865 ft centres, requiring a total length of 3798 ft in three rolls. Designed to carry either loose or bagged artificial fertilizer, the belt is supported by troughing idlers with a roll diameter of of 4½ in. at 29½ in. pitch. Return idlers consisting of five rubber discs about 5 in. dia on horizontal shafts

Heat Floor in Cold Store

Due to the fact that heat insulation merely retards, and does not prevent, the flow of heat, the temperature of the subsoil beneath a cold store gradually falls. This may cause any moisture contained in the subsoil to freeze and expand, forcing up floors and displacing foundations. Because of this a new −20° F cold food store in Cleethorpes makes use of a modified "Panelec" floor heating system. The anti-floor heave system ensures that the subsoil is kept at optimum temperature, thus preventing any damage to the building.

The store comprises two large refrigeration chambers with a floor area of 20,000 sq ft each and a break-up room covering 3000 sq ft. A Panelec floor heave protection mat has been incorporated in a 1½-in. screed laid beneath the insulation under each floor. Loads in the freezing and break-up rooms are respectively 123·75 kW and 12·75 kW.

Individual systems are controlled by a temperature indicating thermometer regulator, the sensitive element of which is laid on the level of the floor mat. The instrument is pre-set to switch the floor heating on when the temperature falls below 35° F.

British Insulated Callender's Cables Limited (Panelec Heating Division) manufactured and supplied the heating systems which were installed by the Electrical Contractor, Messrs. Harry Carr Limited, of Grimsby. The consulting engineers and architects were Messrs. Jenkins, Potter, Manning and Clamp of Lincolns Inn Fields, London WC1.

Germanium for Outer Space

A new method of making germanium crystals may lead to the development of outer-space electronic equipment which is very much smaller and lighter than is possible at present: one estimate is 1000 times smaller. The development stems from research which has resulted in growing germanium crystals as thin, uniform, flat ribbons.

The Westinghouse Electric Corporation has undertaken a development programme to design equipment with inherent life for the job, with greatly reduced energy consumption, and greatly reduced size, the latter mainly to increase instrumentation.

In the new germanium growing technique, discovered in the Westinghouse Research Laboratories, the material grows exactly in the exact form in which this semiconducting material is used for practical purposes in transistors and similar devices.

As an example of the size and weight reduction possible, the most modern system for measuring the intensity of light in space has a volume of about one cubic inch and a weight of about seven grams. A new experimental system has a volume of one thousandth of a cubic inch and a total weight of two one-hundredths of a gram, and it not only measures change in light intensity but also produces a signal capable of transmission.

The new dentritic germanium is the proper thickness for direct use and avoids the present necessity of ingot slicing and wafer grinding, cutting and polishing.

Flash Annealing

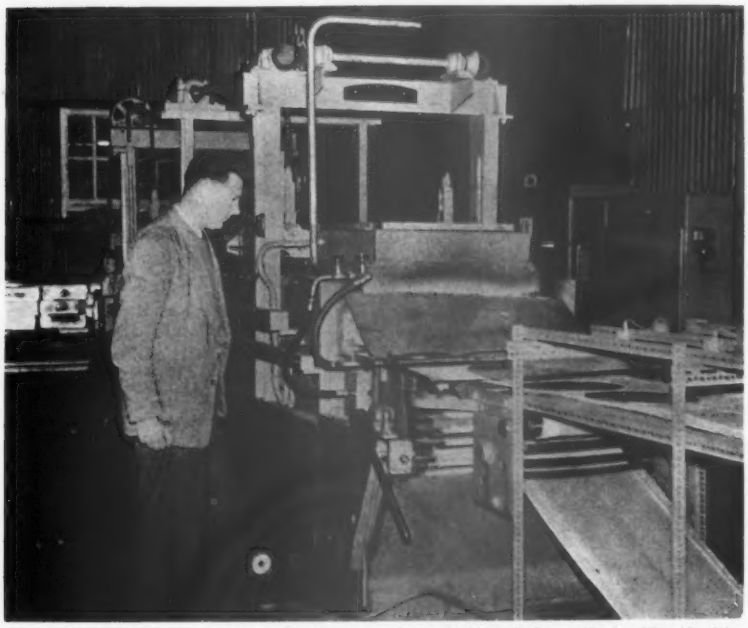
A new type of continuous flash annealing furnace is being operated by The Aluminium Corporation Limited at their Dolgarrog Works in North Wales. Circles of aluminium manganese alloy are heated rapidly by radiation, to produce the fine grain structure needed for deep drawing. Results comparable with salt bath treatment are being achieved with freedom from distortion, staining and surface damage.

The radiation is obtained from heating panels which are fitted with heavy gauge nickel-chrome heating elements and positioned in the roof and the hearth of the furnace.

Variations in heating rates are readily made by adjusting the spacing of the panels from the work, the roof and hearth being built as separate units suspended from the main framework of the furnace and contra-balanced. These units are moved by synchronously driven jacks operated by hand wheels which allow fine adjustments to be made. The furnace can be opened in this way to give easy access to the interior and the heating elements. A gauge is provided to show the spacing of the heating panels from the charge.

The sides of the furnace are supported on a floor standing framework and are enclosed in a sheet metal casing. Vertical sliding doors at both ends allow the entrance and exit to the heating chamber to be closed as far as possible to reduce heat losses.

The charge is carried through the furnace on a horizontal conveyor which has two endless chains running along the sides and carrying cross flights of heat resisting steel covered with woven asbestos cloth to provide a non-abrasive support. The conveyor is driven by a squirrel cage motor through reduction gear. Its speed can be varied between 4 and 30 feet a minute.



Royce flash annealing furnace which uses radiant heating panels, installed in the Dolgarrog Works of The Aluminium Corporation Limited

To avoid temperature fluctuations the elements are supported in grooved refractories of high density which, having a high heat content, serve as a heat reservoir. The temperature of the furnace is controlled in four independent zones, the automatic indicating controllers being used not to switch the element supply but to regulate the supply voltage. The conveyor temperature is maintained as far as possible when it leaves the heating chamber by providing a closed and heat insulated return path.

The furnace has a rating of 90 kW. It provides temperatures up to 900° C and has a heating chamber 21 in. wide by 15 ft long. Heating times for circles ranging from 6 in. to 20 in. dia and from 0·020 in. to 0·080 in. thick vary from 1½ to 4 min. The output of circles of 18 gauge material, 12 in. dia is a little over 2 cwt per hr.

The furnace was designed and made by Royce Electric Furnaces Limited in conjunction with the Aluminium Corporation Limited.

VTOL Aircraft Welded Ducting

The aerodynamic control of the Short SC.1 research aeroplane, Britain's first all jet-powered vertical take-off and landing aircraft, while it is hovering, is analogous to balancing a plate on a pencil. Control is effected by an auxiliary system of ducting which carries high pressure air from the engine compressors to outlet nozzles on the extremities of the aircraft. At the tips of wings, nose and tail, controllable jets of air maintain fore-and-aft and lateral stability by differential operation.

The weight of the control system has been cut to a minimum by fabricating the ducting from sheet aluminium, welded longitudinally by means of the Argonarc process on equipment supplied by British Oxygen Gases Limited. High quality welds are obviously of vital importance, since a failure in the structure would lead to complete loss of control, and the Argonarc equipment has enabled the use of aluminium without the limitations imposed by the use of corrosive fluxes.

The SC.1 is powered by five Rolls Royce RB 108 engines. Four of these are installed vertically in a central engine bay to provide lift, while the fifth exhausts horizontally at the tail for thrust in forward flight. The four lifting engines are mounted in cross-wise pairs, each pair swinging on an axis, so that their thrust centre can be directed fore or aft on transition from vertical to forward flight or vice versa.

Steel in 1958

The annual report of the British Iron and Steel Federation for 1958 shows that last year was a difficult one for the British steel industry, which felt the full effect of the general slackening of economic activity in the United Kingdom and most other industrialized countries. Although the capacity of the British steel industry continued to expand, crude steel production fell by over two million ingot tons from the 1957 record total to 19·6 million ingot tons. There was a progressive decline in the demand for steel from the home market and exports did not

reach the high level attained in 1957. Nevertheless, the industry retained its share of the world market in steel. There was significant saving in imports in 1958.

The set-back in demand is regarded as a purely temporary pause in the long term rising trend. The industry is continuing to plan its development accordingly. Capital expenditure was at a record rate of £105 million in 1958 compared with £95 million in 1957 and £75 million in 1956. The development programme is expected to be fully adequate to meet any foreseeable increase in demand.

The prospects of an early recovery in the demand for steel are now encouraging. The measures taken by the government to stimulate the economy should help to buttress the revival of confidence and production and orders are now beginning to rise.

Cold Bend Testing

The motor driven cold bend testing machine shown in the accompanying illustration is for bending iron or steel bars up to 2 in. square or plates up to 6 in. wide. The specimen to be tested is bent to a maximum angle of 180° round a centre pin, five standard sizes of pins being used. The pusher pin, which is mounted on a substantial table, is readily adjusted in relation to the centre pin so that a perfectly round bend may be obtained. A graduated scale is provided round the moving table so that the angle of bend of the specimen may be noted at any time during the test.

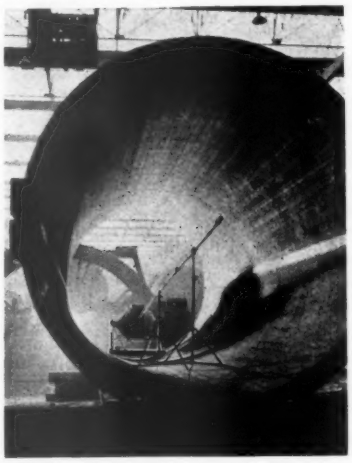
A cold bending machine for testing bars up to 2 in. square and plates up to 6 in. wide. Bends of up to 180° can be made

The load is applied by a 5 hp motor through a worm gear reduction to the table which is a steel casting. Heavy steel plate and wire mesh guards are provided to protect the operator against possible injury from fracture of the specimen during the test.

The machine was built by Edward G. Herbert Limited, Atlas Works, Levenshulme, Manchester, under Licence from the Tinius Olsen Testing Machine Company, Philadelphia, U.S.A. for whom Edward G. Herbert Limited act as sole agents in Great Britain and Eire.

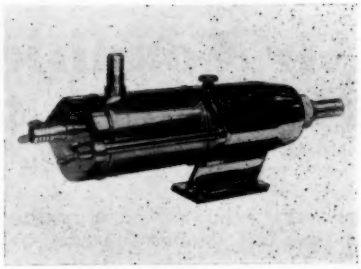
Panoramic Inspection

The use of radioactive sources for the non-destructive testing of metals is increasing generally in industry, and the accompanying illustration shows equipment in use for this purpose at the works of Nuclear Engineering Limited, Woolwich Road, London SE7.



With this apparatus a radioactive source is moved by remote control from the shielding container seen in the distance, to the end of the guide tube. Film is placed over the weld on the outside of the vessel so that gammagraphs of the whole weld are made with one exposure

A guide-tube is positioned at the centre of a vessel for inspection of a circumferential weld, the film having been placed over the weld all round the outside of the vessel. By use of a remote control box, the radioactive source is caused to move out of the shielding container to the end of the guide-tube set-up. From this position the radiation passes through all parts of the weld so that a set of gammagraphs of the whole weld are produced with one exposure. After processing, the films are inspected for defects by viewing on an illuminator in the usual way.



HEART PUMP FOR INDUSTRY.—Originally developed as a heart pump, to take over the circulation of the blood while a patient's heart is out of action during an operation, this Mono pump is put forward for application in research work or in pilot plants where the liquids may be easily damaged and the utmost hygiene is required. It has a helical stainless steel rotor revolving in a stator of resilient material. It can be dismantled without tools and the pump is in the form of a cartridge which can be simply attached to the drive by a pin through the driving shaft

Steel Plant in Spain

The largest and most modern steelworks in Spain, the 42 in. reversing mill of Empresa National Siderurgica, S.A. (Ensidesa) at Alviles and which recently started steel production had the major part of the electrical equipment engineered by the Metal Industries Division of The English Electric Company.

The mill is the first twin-drive in Spain and is designed to give an output of up to 1,000,000 tons of blooms per year. The two 3500 hp (r.m.s.) motors, capable of peak torque of 250 metre-tons up to 50 rpm and cut-out peak of 300 metre-tons, were made at the Stafford Works of English Electric.

The company has also supplied the L.T.A.C. and 6 kV switchgear, 75 MVA transformer and the control gear. Certain items of the electrical equipment, including the Ward Leonard d.c. auxiliary motors, the L.T.A.C. motors and ventilation equipment, were made in Spain to English Electric specification.

Some idea of the complexity of the complete installation can be gauged from the fact that some 14,000 electrical connexions had to be made for the main drive and auxiliaries. Erection and commissioning were carried out by the company's engineers.

The electrical equipment for the associated structural mill has also been engineered and manufactured by English Electric and is currently being installed. This second mill will be commissioned about the end of 1959.

Air Conditioning with Special Reference to Self-contained Units

Air conditioning is essential for certain production processes, in the manufacture of certain drugs, for some surgical operations and for ambient control where human efficiency is paramount. It pays dividends in many other applications and adds to health and comfort where climatic conditions are severe. For large spaces and precise control there is no alternative to the central conditioning system, but for the great bulk of new applications the unit conditioner offers economy and adaptability

By H. POLLAK

THE often repeated saying that mankind developed advanced levels of civilization as a result of favourable climatic conditions can nowadays be proved to be correct: also in the reverse sense. History shows that where man was not compelled by the vagaries of the climate to devote his entire activities to a fight with the elements for bare survival, he had time to improve his living conditions in terms of clothing, housing, food and leisure, advanced mentally and spiritually and produced works of art. Technological progress spread, especially since the industrial revolution, to practically every corner of the world and it brought wealth to places rich in mineral resources, industriousness and ingenuity of the population, irrespective of the climate. With such wealth it is now possible to change the adverse climate on a varying scale by means of a rising new industry—air conditioning.

No longer is it necessary to dread the parching heat of the Arabian desert, holding some of the richest sources of oil, for air conditioned accommodation and offices exclude the 120° F in the shade outside; members of polar expeditions can be kept in good fettle in heated suits and air conditioned huts; sleep is possible as a result of air conditioning in the hot and terribly humid areas of West Africa. Medicaments are produced in sterile atmospheres; offices are kept at conditions to suit the occupant's whim; bananas are ripened at will; crane cabins in steelworks are made bearable and life generally is turned more pleasant, healthy and vigorous by controlling the temperature, the humidity, the cleanliness and the movement of the air in which we live. Air conditioning means just that, and as our real standard of living rises air conditioning will play an ever increasing part.

The mechanical engineer engaged in any of the numerous branches of the industry cannot afford to neglect air conditioning. Quite apart from its importance to comfort and thus to the improvement of working conditions, it creates an atmospheric environment conducive to greater output and services of higher quality. It therefore functions indirectly as a tool of production. This article deals with the fundamentals of air conditioning, with its practical applications and the ways and means by which desirable conditions can be achieved.

Air conditioning is defined as the simultaneous control of temperature and humidity and the cleaning and movement of air. For our purpose it is sufficient to consider that air conditioning is concerned mainly with the control of temperature and humidity. In this connexion it is necessary to recognize that the control of these conditions can be either:

(a) to hold conditions on the right side of a desirable or critical point

or (b) to achieve minimum variation from an optimum or desirable level by accurate control.

The purpose of air conditioning is to control indoor weather rather than fight seasonal battles with climatic vagaries.

From the point of view of application it is best to divide the functions of air conditioning into industrial applications and comfort applications, bearing in mind that hardly ever is there a clear distinction between the two. Generally the effect of air conditioning for manufacturing purposes is also in line with comfort requirements, and comfort requirements in their turn produce conditions which are generally not detrimental to manufacturing processes.

The human body can be considered as a normal heat engine consuming in the form of food a certain amount of energy, a minor portion of which is turned to useful purpose in immediate mental or body activity or is stored away for use later, and a larger part, approximately 70%, is wasted and has to be disposed of as heat. The body processes are tied to a particular temperature at which the whole organism functions most efficiently. Should for any reason the body temperature rise or drop by a very small amount this equilibrium is upset and a very complex regulating mechanism comes into action to bring the temperature back to normal. Under extremes of warmth or cold it becomes progressively more and more difficult to maintain the optimum body temperature and we experience heat stress in its various degrees. Basically heat stress is a danger signal and it automatically results in such adjustment of our activity to bring the temperature back to normal. It can therefore be said that the purpose of comfort air conditioning is to free the individual from the influences of heat stress and not to provide comfort as such.

The threshholds of heat stress vary from person to person and depend upon such factors as age, sex, degree of acclimatization and personal health. Freedom from heat stress results in more and better work with less fatigue, but it can also be proved to improve the rate of learning, to increase the appetite and therefore make customers eat more in restaurants, make them buy more in stores, although there is a difficulty in quantitatively assessing the merits of air conditioning in this respect.

One aspect of the benefit to be derived from air conditioning in industry and particularly in manufacture

is, therefore, already obvious, but industrial air conditioning is generally accepted to apply to materials and equipment only, With respect to materials the purpose of air conditioning is twofold: to bring out the best qualities of the materials handled and, probably more important, to make certain materials more manageable in production. In this connexion it is necessary to emphasize that certain processes and certain materials would not be available on the market at all, or not at the prices we pay for them, if air conditioning did not enter at one or more stages into their manufacture: examples are the artificial textile fibres, drugs and medicines manufactured in sterile conditions, and the consistent miniature elements of our control instruments. It enables automatic high speed machinery to be used in confectionery manufacture; it makes accurate multi-colour printing possible without faults in registering; and it helps in the curing and ripening of certain vegetables and fruit.

In contrast to the materials handled and of rising importance with the increased accuracy of machinery required by modern industry, air conditioning is used for the elimination of dimensional fluctuation in machine components and of the equipment being manufactured. To illustrate, certain hygroscopic materials are subject to a tremendous dimensional variation with a small increase in humidity; this makes manufacture difficult and under certain circumstances virtually impossible. The control of humidity in such instances reduces the incidence of rejects and makes possible a high rate of production. The same applies to a lesser extent to temperature and has been discovered mainly in the manufacture and gauging of very small, accurate parts. The progressive heating of a machine after starting and during the first 20 min of manufacture can distort the tools and result in components outside tolerance limits. In order to achieve accurate and consistent gauging it may be necessary to leave the items to be gauged and the gauges in a constant temperature room for stabilization. A change of temperature and humidity resulting from the heating up of the machine shop may affect the slip of belts, the stopping and starting time of clutches and brakes, and affect the consistency of production. Finally, it is necessary to bear in mind that accurate weighing is affected by the humidity film on the scale basket, which in turn is affected by the relative humidity of the surrounding air.

In all these fields it is possible to assess quite accurately how much can be saved by the introduction of air conditioning. Its ready acceptance by industry is probably due to this ease with which its advantages can be evaluated in terms of money.

All the functions of air conditioning are achieved by passing the air through a series of pieces of equipment connected by ducting and arranged in what is normally called the central air conditioning plant. Let us then follow the path of the air through an air conditioning plant and note the various stages through which it is passing. On entering the plant, outside air ("fresh air" as it is generally called, although it is often anything but fresh) is mixed with the return air from the space to be air conditioned. This return air is nearer the desired indoor temperature and by its use saving in either heating or cooling can be made. The mixing of the two air streams is produced by dampers which can be actuated automatically by pneumatic or electric damper motors. Following its course, the air is then cleaned of dust and lint by air filters of either dry or viscous type, the former normally of the throw-away type, the latter normally permanent. If a high air filtration efficiency is required, electrostatic precipitation follows. In many large plants the air then passes through an air washer where it is intimately mixed with a fine mist of water and, depending on the temperature of this water, is either heated and humidified or cooled. The washer is often preceded by a pre-heater, mainly to prevent damage by frost and it is followed by an after heater to adjust the temperature of the air to the final requirements. These heaters are finned tube batteries fed by steam or hot water, but with small plants indirect gas or oil heating is common and electrical resistance elements are also frequently used. After this final conditioning the air is drawn into a fan, centrifugal or axial, and blown into the space to be air conditioned by means of sheet metal ducts. Even distribution is achieved by a network of branches and individual, sometimes adjustable outlets. In this space the air either absorbs or liberates heat or moisture, depending on the air conditioning function, and is then partly returned to the plant for re-conditioning.

Important auxiliary components are located outside the air stream. Steam or hot water from a central plant is used to supply heat to the water in the washer, and mechanical refrigeration to extract heat. This latter is generally of the compression type with a reciprocating compressor, water chiller and water or air cooled condenser. The water so cooled or heated is circulated through the washer by a centrifugal pump direct coupled to an electric motor. The refrigeration compressor is more often belt driven from an electric motor but the hermetic direct coupled motor compressor, when available, is rapidly gaining ground. The centrifugal fan is generally belt driven from the motor whereas axial fans, if used, are generally direct coupled.

The whole air conditioning system is, of course, only as good as its controls and the field of automatic control for air conditioning plants has shown a marked development. The controls can either be pneumatic, where valves and dampers are moved by compressed air from a small compressor plant, or they can be electric. The electric controls, which are becoming more common, are of two types. In the full voltage type the sensitive element controls the appliance, such as the damper motor, valve motor or a fan pump or compressor motor directly and on mains voltage; the system is simple and generally results in lower first costs. A more accurate control and reliability in operation is obtained by low voltage controls with electronic amplifiers by means of which interlocking of the controls is easily secured.

Sensing elements in an electrical control system can again be mechanically actuated switches—thermal expansion of a bi-metallic strip or fluid expansion in a capsule in thermostats, contraction of human hair, or parchment in humidistats, movement of a float in a level control, etc.—or purely electrical relying on the reaction of the heated resistance wire, a thermistor or the current from a thermocouple with thermostats, the electric resistance of a chemically treated fabric with humidistats, the photo-electric cell with level control, etc. The simplest control is, of course, the "on/off" or step control, but electrical control circuits lend themselves admirably to proportional control where by means of the wheatstone bridge a deviation at the measuring point causes the control to effect a movement proportional to this deviation in the controlled element. In addition, proportional compensation (anticipated indoor temperature by outdoor temperature change) and sequence operation of

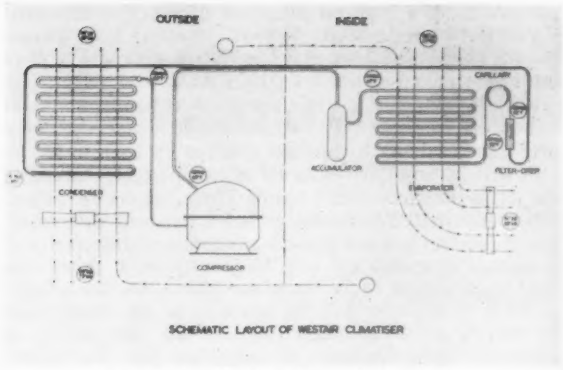


Fig. 1.—Refrigeration circuit of air-to-air air conditioner

Fig. 2.—Exploded view of a window type air conditioner

controlled elements (such as first closing the dampers and then opening the heater valve) is possible.

Originally, all air conditioning plants were tailor-made and only when the demand for air conditioning rose to large proportions was it possible to distinguish certain preferential sizes and start production of these sizes in larger numbers and at a resulting lower cost. The previous description of an air conditioning plant applies to a tailor-made plant where each component is sized for the particular requirement and where, according to the application, all the components are present, or certain of them have been omitted. The self-contained air conditioner, in view of the fact that some compromise is necessary in providing as many different air conditioning functions as possible in a reasonably sized casing, is generally limited to cooling, dehumidification, ventilation, filtration, automatic control of temperature and sometimes heating. The major part of such an air conditioner is the refrigeration circuit and it was only when the reliable and reasonably priced hermetic refrigeration system appeared on the market that self-contained air conditioners became popular.

The self-contained air conditioners, again, can be divided into the free standing type which is generally water cooled, ranging in capacity from 36,000 to 240,000 B.t.u./hr and the heat extraction and the window type, which is generally air cooled, ranging from 6000 to 24,000 B.t.u./hr heat extraction. In the last few years the tropical parts of the world and certain countries with a very high standard of living have been swept by a vogue in self-contained air conditioners and it is, therefore, opportune to describe a particular unit in greater detail.

The basic components of an air-to-air comfort unit conditioner are shown diagrammatically in Fig. 1. The refrigeration circuit consists of the cooling coil (the evaporator) where the refrigerant is boiled off by heat from the air coming into contact with it, and the compressor which pumps away the vapour as it is formed and

Fig. 3.—Air conditioned tannery test room showing air conditioner with control and recording instruments

displaces it into the condenser in which the high pressure refrigerant vapour turns to liquid again, releasing a certain amount of heat which is carried away continuously by means of a special supply of outside air. This liquid refrigerant is then pumped back to the evaporator through a constant throttling restrictor which reduces the pressure generated by the compressor in the condenser down to the evaporator level. The effect of the cooling coil would be localized if no provision were made to circulate the air continuously over it. In practice, hot room air is drawn over it by a fan. The air is cooled by contact with the cooled coil, and if it is wet part of its humidity is condensed on the cool surface. Thus cooled and dehumidified it is blown back into the room. During its passage through the air conditioner it is cleaned of dust, dirt and pollen. Provision is made to vary the quantity of air handled and to admit outside fresh air at will. The heat rejected at the condenser, which to a large extent is the heat absorbed in the cooling coil, is carried away continuously by a separate air circulation. The diagram also shows the different temperatures and pressures of the air and the refrigerant in the different parts of the refrigeration circuit. The actual layout of the unit is shown in Fig. 2. Its electrical controls are arranged for operating it as a ventilator, for cooling in two capacities, and for extracting used room air. Heating is provided by a resistance heater of suitable capacity to correspond to the cooling capacity available. A liquid filled thermostat, the sensitive element of which is in the return air duct and the function of which is reversed by means of a relay, provides the thermostatic control both on the cooling and on the heating cycles.

The availability on the market of self-contained, easily installed and reasonably priced equipment for the control of temperature, humidity and air cleanliness opened very many new fields for air conditioning, fields which were barred to the air conditioning of the central plant type. Its main assets are the individual control at the finger tip of the person using the room in which an air conditioner is installed, the exclusion of outside noise because windows can be kept closed, the cleanliness of the atmosphere reflected on decorations and room fittings, and the ease of installation and dependability of the equipment. They are thus specially suitable for places where a small space needs such control or where they are an addition to a central heating system, also where certain executive offices are treated with special consideration to the occupants, and in particular where alterations

in office layout in an old existing building require air conditioning at low cost in certain locations. A multiple installation of self-contained units has an inherent safety factor in so far that, in contrast to a central plant where the failure of one component makes the whole installation inoperative, with an installation consisting of a number of self-contained air conditioners a complete failure is practically impossible.

The home market for self-contained unit air conditioners is limited by Customs and Excise Regulations to commercial and industrial users and the following are some applications where they have proved eminently successful both from the point of view of technical results and the first running costs.

As mentioned earlier, certain special manufacturing areas, test rooms and gauge rooms require a constant temperature and humidity. Where the size of such a room is below 10,000 cu ft and where the heat generated by the manufacturing process is not excessive, self-contained air conditioners provide the most economical answer. Fig. 3 shows an air conditioning installation in a tannery test room of some 1250 cu ft where the desirable conditions specified by British Standards are 20° C ± 2° and 65% relative humidity ± 2%.

A special tailor-made central air conditioning plant involving the design and manufacture of miniature components proved quite uneconomical in ordinary conditions. The installation of a self-contained air conditioner providing cooling, heating, dehumidification, air filtration and ventilation in conjunction with a self-contained humidifier of the mechanically vaporizing type, both pieces of equipment controlled by two wall mounted thermostats, one for heating, one for cooling, and two wall mounted humidistats, one for humidification and one for dehumidification, achieved the required conditions at a fraction of the first and running costs of a special central plant.

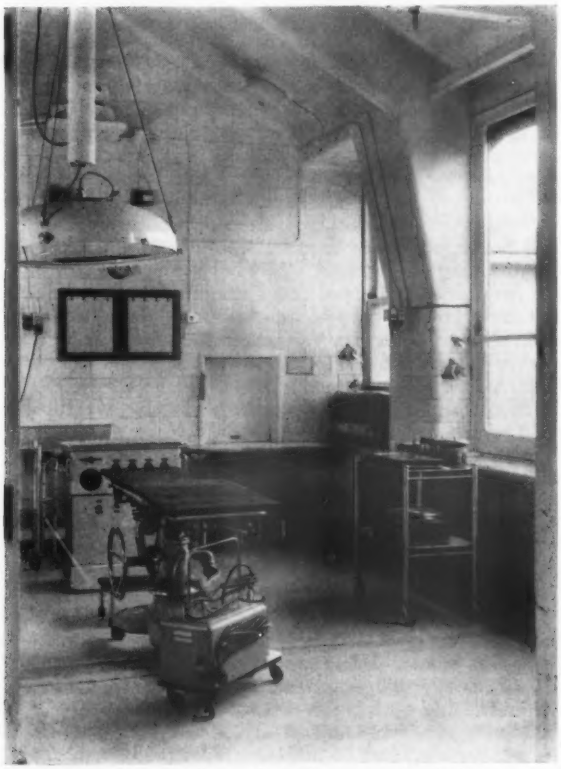


Fig. 4.—Air conditioners for cooling an operating theatre

The desirable conditions in operating theatres vary with the operating methods used and in particular with the part of the body affected. It is taken for granted that no cooling is required to provide comfort levels for the patient and operating staff for all ordinary operations in this country. With certain brain and heart operations a new technique has recently been introduced calling for low temperature in the operating theatre which cannot be achieved otherwise than by mechanical refrigeration. Combined with the low temperature requirements is a diametrically opposite requirement of humidity above 65% to prevent static electricity hazards. The hospital funds available for the provision of specialized air conditioning plant, are generally, not sufficient for a central tailor-made plant. Here again, self-contained air conditioners specially modified to provide safety against explosion hazards resulting from the use of anaesthetics, combined with humidity control to keep the relative humidity of the air at or about 65% R.H., have proved entirely successful (Fig. 4).

How air conditioning can directly affect the incidence of error has been proved beyond any doubt with air traffic controllers. They have an extremely exacting and responsible job, both in terms of human life and in the value of the aircraft involved. Their job is progressively becoming more difficult by the increasing density of air traffic and by the increase in the speed of the aircraft. Located in exposed "glass houses" on top of air control towers they are surrounded by heat generating equipment and a tremendous amount of glazed area with very low heat capacity. The temperature in the control room can therefore change rapidly from a very low level to that of a hot house, with adverse result on the controller's efficiency and on the incidence of error. Fig. 5 shows the air conditioning of such a control room. The installation of self-contained air conditioners makes the air conditioning system flexible, foolproof and safe against failure and gives the controller a choice of either automatic operation or an over-riding control to suit the personal requirements of the staff.

The increasing use of involved and complicated office machinery, in particular accounting machines and electronic computers has opened up a new field for self-

Fig. 5.—Air traffic control room showing two air conditioners and remote control panel

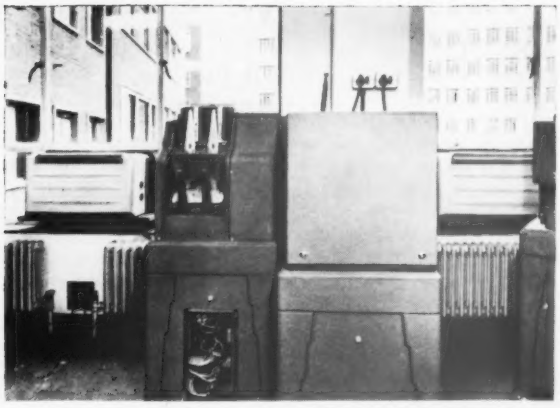


Fig. 6.—Two air conditioners providing comfort in I.B.M. computer room

contained air conditioners. With many of these machines the electrical and electronic components are accommodated in the smallest possible space and whilst these components are temperature sensitive they also produce considerable amounts of heat as a result of their normal operation. Mechanical cooling is thus necessary to keep the equipment in working order but it is also more than necessary to remove the heat radiated from these machines into the computer room and affecting adversely the operating staff. In this connexion self-contained air conditioners are used in a closed air circuit providing cooling of the electronic parts of such machines and in addition to extract the heat liberated into the computer room and provide a comfort level for the personnel (Fig. 6).

It is virtually impossible to satisfy people occupying adjacent offices in a suite by means of a central air conditioning plant; with the use of self-contained air conditioners the occupants of adjacent offices can adjust the levels to their individual requirements and in addition can vary the temperature to suit their momentary whim. Whilst it is difficult to assess quantitatively the value of air conditioning in such instances it is beyond any doubt that the provision of individually adjustable temperature level in the offices eliminates many causes of dissatisfaction and helps to reduce personnel turnover (Fig. 7).

In the export field, self-contained air conditioners are used mainly for personal comfort, whether it be in hotel rooms where they ensure a refreshing undisturbed sleep in the tropical parts of the world, in homes and places of entertainment where they enable people to enjoy themselves and to live a fuller life in spite of the vagaries of the climate outside, and finally in places of work and manufacture where they increase the working efficiency and the productivity of the people.

The increase in the appreciation of the dividend to be derived from air conditioning is evident not only in the industrial sector where the saving resulting from the application of air conditioning can be more easily assessed in terms of money, but also in the field of comfort where such quantitative appreciation is more difficult but where the benefits derived cannot be denied. This combined with the fact that an increasing demand and an increasing production is progressively bringing down the first cost of both self-contained air conditioners and central air conditioning plants into the field of availability to a larger part of our population, is inevitably

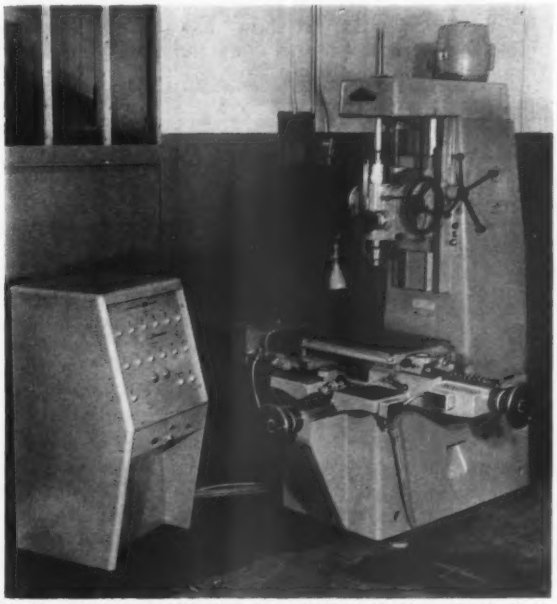
Fig. 7.—Self-contained air conditioner in modern office built into a piece of office furniture and without projection outside double glazing

bringing about a boom for this new air conditioning industry.

The question may be asked: where is a central plant indicated in contrast to a self-contained air conditioner installation? Whilst there is no hard and fast rule, it can be proved that wherever installation and maintenance costs are high and where control of temperature and humidity is not required with such accuracy, and finally where the space to be air conditioned is not excessive, the self-contained air conditioner is indicated and can be proved to be more economical; where the air conditioning load is high, where accurate control of both temperature and humidity is required and where the desirable conditions are identical for a large space, a central plant is necessary. There is, however, a tendency which cannot be neglected in a summary like this, namely that self-contained air conditioners are increasing in capacity and that they are progressively invading the field which, up to fairly recently, was the privilege of central air conditioning plant. The principle of relegating all the specialized and accurate work to the manufacturing area, relieving the installation and maintenance people of the need for high skill, combined with the desire of the manufacturers to produce standard equipment in large quantities, may in due course revise the picture completely in favour of self-contained plant.

There is no doubt that air conditioning has proved beneficial in places of adverse climatic conditions and in doing so, and in improving conditions in more temperate zones, has contributed to the appreciation and to the raising of the general standard of comfort. It is, however, also becoming an increasingly important tool in production, and furthermore an item of the export trade on which so much in Britain depends.

The author is indebted to the Lancashire Tanning Company Limited, Littleborough, the Management of Guy's Hospital, London, to the Ministry of Transport and Civil Aviation, to the Anglo American Corporation of South America, to J. Sebag & Co. Limited and to Westool Limited, the manufacturers of Westair air conditioning equipment, for permission to publish the material used in this article.



The Newall Spacematic 1520 Jig Boring and Milling Machine equipped with the Airmec Autoset system for automatic co-ordinate setting

Auto-positioning on a Jig Borer to 0.0005 in.

To speed up production times when an overall accuracy of 0·0005 in. is adequate the latest version of the Newall 1520 jig boring and milling machine has been equipped with automatic positioning. This together with the Newall patented roller measuring system which enables table settings to within 0·0001 in. to be made, gives the machine a dual role, for it frequently happens that in one component the two classes of tolerances are required. In such cases the two measuring systems which are easily brought to the same datum in relation to each other and the workpiece, may be used in conjunction according to requirements.

The Newall 1520 jig borer is of open-sided design to permit machining of components considerably in excess of the table size, the maximum distance between the spindle nose and the table being 20 in. and from the spindle centre to the column throat 14 in. The nitralloy spindle is mounted between a precision taper roller bearing at the lower end and a double purpose bearing at the top, and the entire assembly is pre-loaded and grease packed during fitting. A spindle sleeve with a No. 2 Morse taper bore is supplied as standard; the spindle nose is designed to facilitate rapid tool changing and drive slots of unequal width in the end of the spindle ensure that tools are always located in the same rotational position. Twelve spindle speeds in the range 67–3000 rpm are available and, in addition to fine and coarse hand feeds, three up and down power feeds of 0·0015, 0·003 and 0·006 in. rev. are provided.

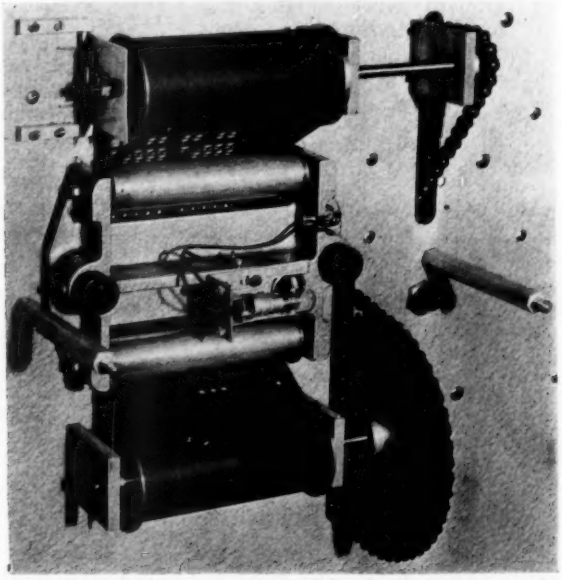
The 20 × 15 in. work table has a longitudinal traverse of 15½ in. and cross traverse of 10½ in. with rapid electrical traverse for both movements of 60 in./min. Three milling feeds of 0·6, 2·4 and 15 in./min for cross slide and table are provided by means of a combination of motor and clutch speeds through selector switches which also have positions for rapid traverse and inching.

Measuring and Control System

The Airmec Autoset measuring and control system, designed and manufactured by Airmec Limited, High Wycombe, Bucks, operates essentially by measuring very accurately the total angular rotation of the hardened and ground leadscrews by means of special commuter type positioning units. In order to hold the inherent accuracy of the system which fundamentally relies on lead screw precision, backlash has been eliminated by arranging that final approach to position always occurs from the same direction; any cumulative lead screw errors are corrected by a cam in the gear box. The equipment is robust and extremely reliable; no valves are used and operation is dependent on low voltage, d.c. switching circuits based on G.P.O. type relays. An outstanding feature of the system is that the positioning unit measures absolute angles and not change of angle as is the general practice on most impulsing systems; the advantage to this is that the worktable automatically positions correctly and no re-zeroing is necessary after any interruption of power failure.

Range of movement of the table under automatic control is 15½ × 10½ in. with an overall accuracy of ± 0·0005 in. on each slide; over shorter distances the accuracy is, of course, to a higher order. Repeatability is approximate to ·00015 in. and the smallest unit of input information is 0·0002 in. (0·005 mm).

The required table and cross-slide ordinates are



Co-ordinate selection is by means of setting dials or by this punched tape reader unit mounted in the rear of the control console

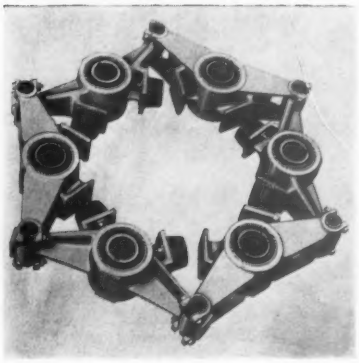
selected by means of either two rows of six dials rotated by hand to the required digits or by a punched paper tape. In the latter case each digit in the co-ordinate is represented by holes punched according to an extremely simple code which can be committed to memory within a few seconds. Since all information for one position is read instantaneously, complicated and expensive memory systems are not necessary. The tape, prepared by means of a simple keyboard type punch included with the equipment, is of tough quality permitting virtually unlimited repeat use. Co-ordinate information for up to 600 operations together with such additional information as stop signals, tools to be used and automatic tape run-back is contained in a relatively short tape.

Automatic positioning is initiated by a single push button and commences with the unclamping of both slides; simultaneous movement of the table and cross slide to the required co-ordinate setting ensues and this is followed by automatic clamping of the slides. On completion of the positioning cycle an electrical signal is given to indicate that machining may commence. During the machining period the tape moves to the succeeding information group and the programmer awaits a signal given by the operator to show that the operation is completed. On receipt of this signal the positioning cycle is recommenced.

Variable Torque Coupling for Marine Drives

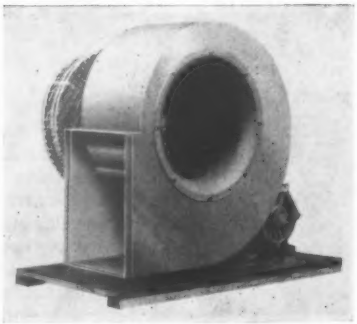
An effective and economical solution to the problem of resonant torsional vibration in marine engine/propeller shaft systems has been made by Metalastik Limited, Evington Valley Road, Leicester, by the development of the Torque Transfer coupling. This coupling which has great torsional flexibility at low speeds has the capacity of stiffening up as the speed increases and the ratio of initial to final stiffness can be varied as required. For the particular design illustrated it is about 1 to 9 but lower as well as higher ratios are possible. This is due to the fact that for low torques, rubber loaded in torsional shear is employed while for higher torques separate rubber buffers, loaded in compression, provide the higher stiffness required.

In view of the torque transmitted and the torsional flexibility provided the Torque Transfer coupling is a very compact device; the coupling illustrated which is only 45 in. dia and 7½ in. wide fits between flywheel and gearbox of a marine diesel engine developing 1000 bhp at 435 rpm. At 6000 lb ft torque, the torsional deflexion is 7¾°. The design is suitable for drives of 500 to 1000 bhp at 435 rpm or equivalent torques at speeds up to 500 rpm.

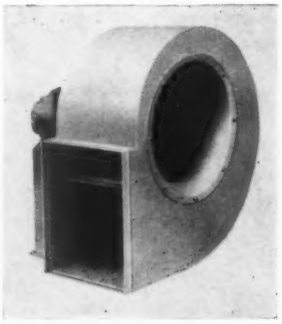


Metalastik Torque Transfer coupling

Basically the coupling consists of two sets of three rocker arms connected at their extremities by means of Metalastik shackle pins. Each arm pivots centrally on a Metalastik Ultra-Duty bush and rubber bonded buffers are bolted to flats formed on three of the rocker arms. Contact with flats on the other set of rockers occurs when a certain torque has been reached and the initial clearance has been taken-up. One set of rockers is connected by three tapered pins to the flywheel and the other set by three pins to the gearbox flange, the inner sleeves of the centre pivot bushes being keyed to the pins.



The QP type belt driven fan available in 8, 10, 12 and 14 in. sizes



The QM type slow speed direct motor driven fan 8, 10 and 12 in. dia for low pressure duties up to 700 cfm

Multi-vane Centrifugal Fans

Two new additions to their Q range of centrifugal fans for ventilation and air conditioning duties are announced by The Standard & Pochin Bros. Limited, Evington Valley Road, Leicester.

The QP type fans are belt driven units available for a range of speeds and duties compactly combining fan, motor and drive into a packaged unit on a wooden base for easy fixing. The forward curved multi-bladed impeller is mounted in ring lubricated sleeve bearings and driven by a ½ bhp 1440 rpm motor. Four fan sizes 8, 10, 12 and 14 in. provide an air volume range of 300 to 1800 cfm.

The QM type fans are compact, slow speed units, direct driven by a patented non-overloading electric motor. Available in three fan sizes. 8, 10 and 12 in. they cover a range of low velocity and pressure duties up to 700 cfm.

AIR COMPRESSOR RECEIVER MOUNTED.— Illustrated above is the 200SR9501 one of two new stationary Hydrovane air compressors manufactured by Alfred Bullows & Sons Limited, Long Street, Walsall. It has an output of 95 cfm at 100 psi and is mounted on a 6 × 2 ft horizontal air receiver. Standard fittings include a water-cooled oil cooler with thermostatic water flow control. The price of this unit is £475 plus 20% and an air-cooled oil cooler can also be supplied at an extra cost

New Uses for Colloidal Graphite

Graphite is the hexagonal crystalline form or allotrope of carbon and is greatly different from the other allotrope, diamond. It is well known as a lubricant but continues to find new and diverse other applications. These are reviewed here, and notes are included on the characteristics of the material and the methods by which it is applied

COLLOIDAL graphite consists of finely-divided particles suspended in a liquid, such as distilled water (Aquadag*), mineral lubricating oil (Oildag*) and other vehicles. As it does not readily combine with oxygen at temperatures below about 500°C, its lubricating properties are useful for such purposes as upper cylinder lubrication. As industrially used, colloidal graphite is so finely divided that its particles will, assuming suitable liquid carriers are employed, remain in a state of indefinite suspension. The particles are so small, in fact, that they are not held back by the type of filtering medium that would normally filter out ordinary finely powdered graphite.

Being made in the electric furnace, this type of graphite is of exceptional purity, and if dispersed throughout a body can be used as a dry lubricant. Furthermore, it is chemically inert and no ordinary reagent attacks it; some of the stronger oxidizing agents do, however, attack it, and included among these are mixtures of H_2SO_4 and HNO_3 as well as $KClO_3$.

Among the carriers are mineral oil, castor oil, water, ethyl and isopropyl alcohols, ketones, glycerol, diethylene, glycol, etc.

One advantage of the fine dispersion and small particle size is that while any solids in a suspension can be filtered out, the graphite particles pass freely through the filter and do not form sedimentary deposits. This means that they can be used without risk in circulating or enclosed systems since they do not obstruct narrow oil passages and are not strained out by the filter.

Nevertheless, when an oil suspension is used in internal combustion engines, it gradually becomes contaminated and acidified as a result of carbon formation, lacquer collection, heat, aeration, water and fuel dilution, combustion products, etc., all of which detritus piles up on the filters and functions as a super-filter capable of eliminating even the finely-dispersed colloidal particles.

Colloidal graphite forms a "Beilby layer" and is so thin that it cannot be seen by normal microscopic methods, and it is homogeneous, giving a dry, oil-free but slippery surface even when contained in a water dispersion. Such a film, technically termed a graphoid surface, has a considerably lower frictional coefficient than plain metal and facilitates the distribution of oil over the lubricated surface.

A metallic surface carrying a graphoid film is itself a lubricant of effective type, so that should there be a failure of the oil supply or the oil is forced out by too heavy a loading, the graphoid will prevent the welding together of the metallic surfaces in contact under pressure; prevent flakes or particles of metal from being torn out and carried into the system as abrasive media; give the necessary lubrication until oil is once more flowing; and facilitate the distribution of oil over the surface owing to the greater spreading power of a graphoid surface than of an ordinary metallic surface.

When colloidal graphite is suspended in mineral oil the total weight of colloidal graphite may be as much as 10%. The oil is of high viscosity and for this reason is let down with a lighter oil. Such a dispersion in oil is known as 'Oildag'. When the graphite is suspended in water it is concentrated into a kind of paste and there is about 18% by weight of the colloidal material in the suspension. Such a dispersion is known as 'Aquadag'.

The oil dispersion reduces friction, prevents seizure and increases the degree of lubrication at elevated temperatures. If it is designed for high temperature lubrication as in those instances where oil or grease cannot be employed, it will give effective lubrication if diluted with a light, low carbon-forming oil in the proportion of 1 part of the oil dispersion to 20 parts of the light oil. Typical applications of the oil dispersion are to bakery, enamelling and annealing ovens, kiln cars and automatic glass bottle machines. It can also be employed for the lubrication of hot dies for making forgings, pressings, stampings and castings. Small mechanisms for which lubrication must be intermittent are also effectively lubricated, and included in these are hot bearings, groaning valves on steam engines, etc. The oil dispersion cools the working parts of machinery and if any have been newly machined, they are enabled to bed down with greater accuracy and with a smaller degree of wear.

The water suspension must be diluted in advance of use with distilled water, and is swabbed, brushed, or sprayed on to the surface to be treated. Application by immersion in a bath of the dispersion is also possible. The dispersion has been and is being successfully applied to steam cylinder lubrication, wire drawing, turbine casing bolts in power plant, high pressure pipe flange studs, superheater element studs and similar threaded parts required to function for protracted periods at high temperatures. The dispersion can also be used as a flange parting compound, and in addition to metals, can be applied to glass, plastics, paper, mica, asbestos and many other materials. Here it fulfils many functions, such as improving electrical or thermal conductivity.

As an impregnating medium it is applied to paper stock, giving, by variation of the dilution, a wide range of conductivity and so modifying the electrical properties

*Registered trade marks, Acheson Colloids Limited.

of the treated paper. Another application is to asbestos fibre to which it gives a degree of lubricating power, electrical conductivity and a darker colour. It is applied to leather for the same purposes, but because this is an extremely dense material, application must be through the pores, whether the hide or the manufactured leather is concerned. The method is to give the surface of the material a large number of extremely fine perforations which are filled up with a concentrated form of the colloidal graphite.

Wood and cork can be impregnated by soaking them in a solution of the graphite, but the most suitable method of impregnation is by means of centrifugal pressure. Sometimes synthetic resins are mixed with colloidal graphite and injected into the lignin.

Another interesting use of the water dispersion is as an impregnant of grinding wheels, which are claimed to be more efficiently abrasive when so treated. This is because the colloidal graphite acts as a dry lubricant and so lowers the losses resulting from friction. Moreover, when the grinding action is electrically controlled, the embodiment of colloidal graphite in the porous minerals of which the wheel is composed gives the wheel conductivity.

There is, lastly, a considerable use for colloidal graphite as an ingredient in various materials, among which may be included paper, cellophane, rayon, Bakelite, ebonite and synthetic resins. Soaps employed in industrial lubrication, non-ferrous alloys, and rubber latex, may also contain colloidal graphite. Sometimes the graphite is added solely as a colouring agent, as when Aquadag is used for calcined gypsum in water. There is also a use for the graphite in waxes, which it makes more opaque, conductive and lubricating.

Reverting to the dispersion products, it may be mentioned that Aquadag is employed to form resistance coatings in variable resistances, and also to provide a conductive film for dissipating static charges of electricity. It is equivalent to mercury as a means of making electrical contacts. In the electronics field it is used as a ray focusing anode material for cathode ray tubes and also for coating the envelopes, grids and plates of radio valves to retard secondary emission and to provide other qualities. Even more recently, suitable dispersions of colloidal graphite are being used for forming conductive coatings on plastics and other non-conducting materials to allow of the later electro-deposition of metal in plating processes.

In using the water dispersion, the concentration of colloidal graphite in the final solution depends on the purpose to be served. If dry films are required, the surface to be coated should be gently heated to a temperature in the region of 100°C. Should a thicker coating be required, it may be necessary to apply it several times, allowing a period for drying between each application. In diluting the dispersion, it is essential that distilled water alone should be used.

In applying the oil dispersion, the first stage is to give the surfaces to be treated an ample coating of four parts oil to one of the dispersion, which is followed by the normal processes of assembly of the parts to be treated. This will serve effectively for the running-in period. If it becomes necessary to employ greater quantities of oil, the dilution may be 50 parts oil to 1 of dispersion, the dilution being thoroughly mixed.

If working conditions are particularly difficult, half a pint of the running-in dilution (4:1) may be added to each gallon of oil. This enables the parts to function more effectively at higher operating temperatures, while at the same time they will withstand the loads involved with a smaller degree of wear.

Temperatures unsuitable for oil or grease need not prevent all lubrication, because the addition of one part oil dispersion to about 20 parts light oil will, as earlier indicated, give high temperature lubrication. The oil used for dilution of the dispersion should be of mineral type and of high quality. It is always advisable to consult the manufacturer as to the best proportion of oil to dispersion for a specific part or purpose.

In this connection, it should be noted that colloidal graphite suspensions carried in liquids can be air-sprayed on hot surfaces, even when these are at temperatures much higher than the boiling points of the carrier liquids. Thus a water dispersion can be sprayed on dies at about 250 to 300°C. White spirit, boiling at about 150° to 170°C can be sprayed on surfaces at temperatures above 400°C. Such temperatures cannot be achieved when the dispersion is simply swabbed on.

Colloidal graphite is highly sensitive, and in order to maintain its characteristics, a number of precautions are necessary. The water suspension should not be allowed to freeze, and if employed in impregnation, must not become contaminated during the process by electrolytes. Reference has been made to the use of centrifugal force as a means of impregnating substances and materials with colloidal graphite. This is achieved by means of special machines which adopt varying hydrostatic pressures which build up as the centrifuge spins faster. The air in the body being impregnated is thus driven forward and the impregnating fluid takes its place. This combination of impregnation with centrifugal drainage renders the eventual product more homogeneous.

Summing up, we may point out that the advantageous properties of graphite when used in colloidal form are its high conductive power for both heat and electricity; its opacity; its ability to absorb or radiate heat; its inertia to chemical attack of a normal character; its non-toxic and non-poisonous property; its ability to withstand low temperatures without apparent effect, and also to withstand neutron irradiation.

The load-carrying capacity of the oil dispersion is such that whereas plain oil fails at a load of just over 600 psi colloidal graphite will continue to give adequate lubrication at a pressure greater than 1000 psi. As regards piston ring wear, 45 hr of running produces only half the wear when colloidal graphite is used as when plain oil is used. Anti-seizure is proved by a test in which plain oil could not prevent a heavily loaded bearing from seizing up very quickly after the oil supply was cut off, whereas the dispersion enabled the bearing to run under identical conditions for an extremely long period without seizure, showing a low frictional coefficient.

Standard Flat Roof Building

A standard steel framed construction for a flat roof or monitor roof building of single or double storey height has been designed by Sanders & Forster Limited, 3 Buckingham Palace Gardens, London SW1. The utmost economy is obtained in the design by using the plastic theory. The maximum use is made of the new universal beams. Standard site connexion details have been prepared for any particular steel section, thus reducing drawing office work to a minimum.

Restricted Flexible Shaft Couplings

The form and arrangement of a flexible coupling depends upon the degree of freedom required in the drive and a number of satisfactory designs are available. At the present time, however, much new work also imposes limitations on space while at the same time often requiring easy detachability. It is in this combination of circumstances that the problem is discussed

By R. WARING-BROWN

IT is frequently necessary, particularly with automation equipment, to couple shafts flexibly. This often occurs where dimensions of length and diameter are restricted and the use of standard coupling units is precluded and therefore couplings have to be specially designed.

In the light of modern research it would seem that every shaft coupling should provide some degree of flexibility, and while this may introduce some complexity with modern ideas and using modern materials it is far from impossible.

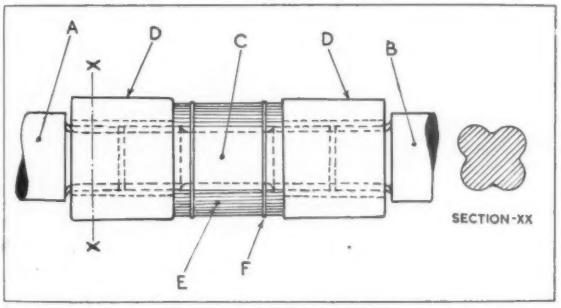


Fig. 1.—Wobbler flexible coupling

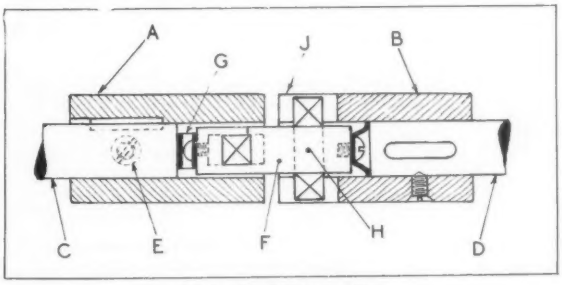


Fig. 2.—Flexible dog coupling

Our present purpose is to consider shaft couplings which are limited in external diameter and which must provide flexibility to cope with axial, radial and angular misalignments to obtain high efficiency and obviate noise and vibration. Further, due regard must be given to maintenance and adjustment.

Satisfactory selection of a shaft coupling depends upon the particular conditions under which it has to operate and the type of machinery involved, and is ultimately founded on experience. Below are given a few examples of current practice and modern ideas, where coupling diameters are comparatively small compared with shaft size.

Wobbler couplings

Although of crude design, these couplings have qualities which make them unrivalled in the presence of considerable grit, water, steam and heat. In Fig. 1 is illustrated an assembly as adopted in steel rolling mills. It acts as a connection between a driving pinion and its corresponding roll. It will be seen that a "breaking spindle" is used which is designed to avoid other and more serious damage by fracture under the severe overload to which such equipment is often subjected.

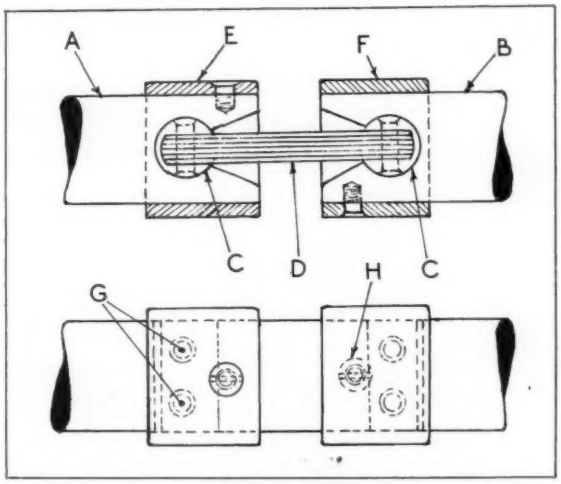


Fig. 3.—Laminated spring flexible coupling

The ends of the roll neck A and the pinion shaft B are of special section, in some instances resembling a four leaved clover, variants being of cruciform construction. The ends of the braking spindle C are similarly formed, being coupled to the pinion and roll shafts by loosely fitting sleeves D. In the final assembly the two sleeves are held apart by pieces of wood E placed in the grooves of the breaking spindle and bound together by wire F, the great advantage of this primitive locking device being that it can be quickly dismounted and replaced at neglible cost.

The work such couplings are called on to perform is extremely arduous, but it will be appreciated that limited flexibility in any direction is attained, although at the expense of a fair amount of noise. However, this is not objectionable in the class of work involved, and excessive noise and vibration will not develop when the coupling is correctly designed to transmit the optimum torque. It will be noted that by sliding one of the sleeves

toward the other, the overall length of the breaking spindle may be kept down to a dimension sufficient to permit its easy removal for severing the connection between the driving pinion and the roll.

It would appear that a refined construction founded on the basic principle might well have a wider appeal where diametral restriction dictates the general arrangement.

Flexible dog couplings

Efforts to devise a simple and effective flexible coupling have resulted in the scheme illustrated in Fig. 2. This compact arrangement, while allowing limited flexibility in the various directions, satisfies the paramount consideration of small diameter. The component has a minimum of parts and has good anti-

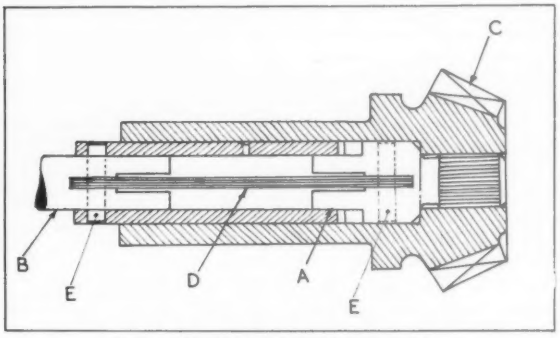


Fig. 4.—Laminated spring bevel drive coupling

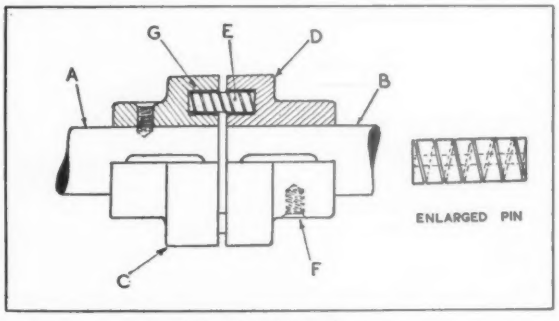


Fig. 5.—Spring pin coupling

vibration qualities. The two shafts C and D to be coupled carry keys to drive sleeves A and B, which are held in position endwise by grub screws, the inner ends of the sleeves being provided with slots J at right angles to each other. There is an intermediate shaft F to the ends of which are fitted two special springs held in position by screws, these springs being arranged to maintain contact between the driving and driven shafts at all times, thereby eliminating end movement, shock and vibration. At a little distance from the ends of the shaft two holes are drilled at 180°, and cross pins H, formed with dog ends, are fitted to give a good sliding fit in the slots of the coupling sleeves. The intermediate shaft should be given a good clearance on the inside of the sleeves, and a gap of about $\frac{1}{4}$ in. should be allowed between the inner ends of the sleeves so that reasonable flexure and end motion may be accommodated. The coupling sleeves should be capable of being slid back on their keys for dismounting, while the springs to distribute the end pressure should have small arms, or alternatively a Belleville washer may be utilized.

This coupling has proved very satisfactory in practice over long periods of service.

Laminated spring coupling

It is sometimes advisable to instal a shaft coupling in a limited space that will give improved flexibility, even though it is more expensive to produce. In Fig. 3 is illustrated a type that comes into this category, and it will be seen that the two shafts A and B to be connected have their inner ends slotted out into holes drilled through the shafts, which latter take comparatively large diameter pins C. These pins are also slotted to take a series of laminated spring plates D which are duly fastened thereto by rivets G.

The pins are hardened and ground and are slid into

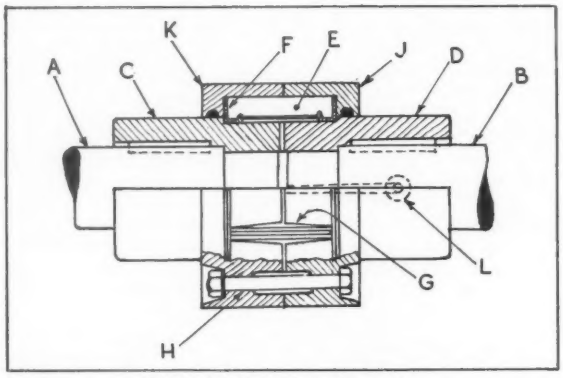


Fig. 6.—Multi-laminated spring coupling

place in the shafts, and sleeves E and F having been slid over their respective shafts are pushed over to protect the pins, being then located by grub screws H, thus preserving a smooth finish without projections on the finished assembly. The coupling was primarily designed for textile machinery to eliminate keys and to transmit the drive but not vibration. It is easily dismounted.

Laminated spring bevel drive coupling

In high class work improved forms of the laminated spring coupling are being very successfully applied. In Fig. 4 is illustrated such an assembly utilized to drive an engine governor, and it will be seen that a bevel pinion C is splined to a shaft A which is slotted to take a laminated spring D, similarly connected at its other end to the driven shaft B. The spring is firmly fixed to the bevel shaft and driven shaft by pins E forced in under pressure. Slight axial movement is allowed, and a positive abutment drive is also provided. In certain classes of machinery such as this it is often necessary to detach expeditiously a driven unit from a prime mover, a factor which this particular construction satisfies.

Another important feature is avoiding the transmission of cyclic variations, and here an improvement consists in making the slots in the shaft ends just wide enough to give sufficient clearance to the laminated spring to allow of some deflexion during operation, so that when the spring attains a resonant condition its increased deflexion will bring the spring plates up to the edges of the slots, thereby shortening their effective length and immediately detuning the system.

In such a scheme misalignment is not allowed, but flexibility in transmission effectively eliminates vibration

and noise. A positive abutment drive is also provided to prevent over stressing the spring plates during overload. To prevent cyclic variation it would be possible to incorporate some form of rubber coupling, but as these generally have a fixed natural frequency of oscillation, they would not prove satisfactory in the coupling required for the particular purpose of the bevel drive described.

It will be apparent that the coupling arrangement is simple and compact while being easily dismountable, but it must be precision built.

Spring pin coupling

At times it is absolutely essential to connect shafts by a coupling capable of dealing with slight deviations in shaft alignment, as for instance in coupling steam turbines, or internal combustion engines to blowers, or other equipment where high speeds of rotation are involved. In Fig. 5 is illustrated a coupling specially developed to operate at high speeds, and in order to render it suitable the dimensions are kept down to a minimum by making the several working parts of high duty steel, hardened and ground.

It will be observed that the so-called pins are built up of a series of tempered steel helical springs of abnormal section, having a very small hole in the middle.

In the sketch two coupling sleeves C and D are shown fitted to the driving shaft A and driven shaft B respectively by means of keys, and are retained horizontally by grub screws F. The coupling sleeves have a series of holes drilled in their faces and subsequently hardened steel bushes G are pressed therein. The helical springs E are located in the pockets thus formed, and are sufficient in number, flexibility and strength to transmit the required torque by the shearing action.

Any flange coupling connecting two shafts that are out of alignment will run open on one side and closed on the other. The endwise motion due to this opening and closing action of the flanges is provided for in this coupling by the universal flexibility of the pins and the fact that the minute clearance between the coils, together with the initial compression put upon them, will accommodate their opening and closing movement.

It should be noted that in practice this scheme has shown a natural propensity for damping out vibration, and also its durability, especially when charged with grease in the central cavities of the spring pins. This coupling exemplifies simplicity in mounting, dismantling and maintenance, while safety is assisted by the smooth exterior, and the diametral dimension is practically down to a minimum.

Multi-spring coupling

For certain classes of machinery couplings are required which give a greater flexibility while catering for the various types of shaft misalignment and simultaneously providing a cushioned drive; although the objective may be difficult to attain without instituting somewhat larger diameters for the coupling, and in addition without rendering the unit unduly expensive.

In Fig. 6 is illustrated a design whose special requirements are not excessive, and is in fact a coupling with multiple laminated springs constructed to deal with high torque and high speed.

In most modern machinery anti-friction bearings play an important part: in consequence any considerable errors in alignment, whether originating from wear, faulty erection, settling of foundations etc., will set up strains and stresses which will subject shafts and bearings to overloads, which may result in increased friction, loss of power, and often to ultimate fracture of parts.

The coupling under review provides for a flexible connection between driving and driven shafts, will transmit high powers, and is eminently suitable for dealing with shock and vibration. As will be seen in the composite drawing, the coupling consists of driving and driven sleeves C and D keyed to the shafts A and B to be connected, the hubs carrying a series of laminated springs E in accurately pitched grooves. These latter are flared, as shown at G, so that the springs are adequately supported under load while retaining their resilience, being also held in position by retaining rings F. The two halves J and K of the outer casing are held together by bolts H passing through the hubs.

The retaining rings F are spigoted together, and so formed as to fit and locate the springs independently of the hubs, to ensure freedom of the latter to take up misalignment.

The successful operation of such a coupling will largely depend upon adequate grease lubrication, and this is arranged as shown at L. Seals are located in the two halves of the outer casing to prevent leakage and the ingress of impurities. Bolts are recessed so that the unit presents a smooth exterior, and specially selected steels are used so that a minimum diameter and maximum strength may be ensured.

Friction Material for Oil Well Drawworks

A new friction material, Ferodo MW48, of solid woven asbestos material, impregnated with a synthetic resin has been specially developed by Ferodo Limited of Chapel-en-le-Frith, Derbyshire, and is now being marketed for oil well drawworks.

Excellent bolt holding capacity is assured by the inclusion, on the band side of the material (i.e. adjacent to the non-working face) of a fine brass wire reinforcement in both the warp and the weft yarns. Ferodo MW48 has a medium/high coefficient of friction and possesses all the characteristics required for drilling operations, good frictional stability, long life and resistance to fade.

The material is normally supplied undrilled in radiused blocks of standard size and thickness with a ground working surface. It can also be supplied drilled to customers' specifications or machine grooved for fitting by the Ferodo Ferolok or American Key-Lok methods.

Non-hardening Oil Resistant Gloves

A new range of industrial gloves and gauntlets is being produced by the Dunlop Rubber Company Limited, General Rubber Goods Division, Cambridge Street, Manchester, from Hycar, a nitrile rubber highly resistant to oils, developed and manufactured by British Geon Limited.

Extensive tests under actual working conditions have proved these gloves especially resistant to petroleum products, vegetable and animal fats, oils, alcohols, glycols, and many common solvents and they do not harden after use.

The Hycar gloves and gauntlets are made in one weight only, in sizes 9, 10 and 11. Enquiries should be addressed to Dunlop Rubber Company Limited.

Review of Progress with Large Nuclear Power Stations in U.S.A.

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F., Consulting Engineer

8. Boiling light water reactor

8.1. Dresden nuclear power station in Illinois

The nuclear reactor and the turbo-generator plant for this station is being designed by the General Electric Company, Schenectady, New York. The station is situated 50 miles from Chicago, and is being built for the Commonwealth Edison Company, and the members of the American Nuclear Power Group for $45,000,000.

1.	Type	Dual pressure boiling water reactor
2.	Operation	1960
3.	Rating	
	Reactor heat output (no losses)	624·2 MW
	Reactor and system losses	627·2 MW
	Gross generator output	192·0 MW
	Auxiliary power	12·0 MW
	Net station output	180·0 MW
	Steam rate to turbine	13·52 lb/kW
	Net station heat rate	11,893 btu/kW hr
	Plant thermal efficiency	28·7%
4.	Fuel	
	Uranium oxide	
	Maximum fuel temperature	3000° F
	Maximum heat flux	300,000 btu/hr/sq ft
	Fuel element	
5.	Moderator	light water
6.	Coolant	light water
	Inlet temperature to reactor	504·8° F
	Outlet temperature from reactor	543° F
	Temperature rise	38·2° F
	Flow through reactor	25,602,000 lb/hr
	Pressure in reactor	1000 psig
7.	Core	
	Dia	10 ft
	Length (active)	9 ft
	Number of fuel channels	700
8.	Vessel	
	12 ft inside dia and 1000 psi	
9.	Steam Separator	
	(To ensure an adequate separation of steam and water)	
10.	Turbine	
	Dual pressure cycle	
	Rating of turbine (3600 rpm)	192 MW
	Rating of generator	0·85 PF, 30 psig H_2 pressure
	High pressure steam at turbine	950 psig
	Low pressure steam at turbine	450 psig
	Number of cylinders	3
	Low pressure turbine	Double flow
	High pressure steam to turbine	1,407,400 lb/hr
	Low pressure steam to turbine	1,187,660 lb/hr
	Total of high pressure and low pressure steam	2,595,060 lb/hr
	Ratio of high pressure to low pressure steam	1·18
	(Moisture separation between high pressure and low pressure turbines)	
	Vacuum in main condenser	27·5 in. Hg
	Cooling water temperature	75° F
	Steam to condenser	1,525,900 lb/hr
	Steam to condenser as % of total through turbine	58·5%
	Final feed temperature	405° F
	(Dual flow five stage feed heating system).	
11.	Turbine building	
	212 ft wide × 92 ft high	
12.	Turbine bay	
	147 ft long, 90 ft wide and 92 ft high.	
13.	Primary steam drum (reservoir and separating device)	
	Water storage volume	1700 cu ft
	Diameter	8 ft 6 in.
	Length	60 ft
14.	Sphere	
	(Contains only the reactor and selected auxiliaries)	
	Diameter	190 ft
	Design pressure	29·5 psig
	Plate thickness at top	1¼ in.
	Plate thickness at grade level	1⅜ in.
	Lowest point of sphere below grade	39 ft
	Opening in sphere	17 ft dia
	Additional openings for ventilation air, steam, water, electric wiring and instrumentation	2 in. to 60 in. dia
	(Bowl-shaped concrete foundation under the sphere for carrying the load of equipment and shielding inside the sphere.)	
15.	Material	
	All surfaces in contact with primary fluid	Stainless steel
	Secondary system	Carbon steel
	Main steam and condensate system	Carbon steel

Tubes for last three heaters — Monel

16. Reactor recirculating pump.
Canned type motor.
Journal and Thrust Bearing made of "Graphitar", water lubricated.

17. Secondary steam generators
Steam is produced at 500 psia. The primary fluid is pumped through the inverted U-tubes. The secondary fluid and the steam separation equipment are contained in the vertical cylinder shell

Steam outlet	12 in.
Feed water inlet	6 in.
Stainless steel cladding	$\frac{3}{8}$ in.

A flow diagram for this station is shown in Fig. 3.

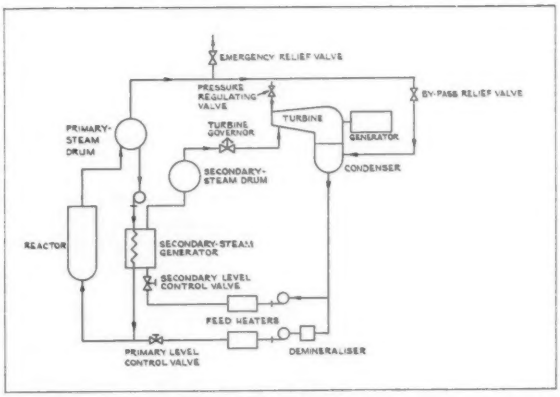


Fig. 3.—Flow diagram of General Electric dual-cycle boiling water reactor for the Dresden atomic power station, near Chicago.
Reactor: heat output (no losses) 624·2 MW; dual pressure boiling water pressure in reactor 1000 psig.
Turbine: 192 MW (gross), 180 MW (net), 3000 rpm; 3 cylinder D.F.L.P. 13·52 lb/kW hr; dual flow five stage F.H. system: H.P. inlet 950 psig, 1407, 400 lb/hr; L.P. inlet 450 psig, 1,187,660 lb/hr; total steam at T.St. valves 2,595,000 lb/hr. Vacuum 27·5" F, C.W.I.T. = 75° F; F.F. temperature = 405° F; net station heat rate = 11,893 B.t.u. kW/hr; thermal efficiency 28·7%

9. Fast breeder sodium-cooled reactor

9.1. The Enrico Fermi power reactor at Lagoona Beach, Lake Erie, near Detroit

1. Type of reactor
Fast breeder, primary and secondary sodium circuits with heat exchanger. The primary sodium circuit and the intermediate heat exchanger are within the containment vessel.

2. Output.

Initial heat	300 MW
Ultimate heat	430 MW
Capacity of turbogenerator	156 MW

3. Core
Core and blanket consist of a cylindrical assembly 6 ft 8 in. dia and 5 ft 10 in. high, containing 91 core elements, 546 radial blankets elements and 10 control rods.
Actual core dimension 31 in. dia and 31 in. high.
Each of the core elements consists of a double-walled tube of 2·646 in. square section.

4. Fuel element
In the form of long thin pins arranged at 0·1917 in. centres. Each fuel pin is formed of uranium-molybdenum alloy enriched to approximately 25% with U235 with zirconium cladding. Final dimension 0·158 in. dia (including 0·004 in. zirconium). Finished length of each pin is $31\frac{3}{16}$ in. Spacing is ensured between pins by stainless steel wires at 2 in. intervals. The lower ends are anchored, the upper being left free for expansion. The square sheath is double walled, there being a thin sheath around the fuel element with a thicker wrapper around it, the pace being maintained by stainless steel wire spiral.

The coolant flows through the space between the sheaths as well as directly around the fuel pins, by this means the temperature gradient through the wrapper is reduced.

Maximum clad temperature	1020° F
Maximum uranium temperature	1300° F

The upper and lower blanket sections have 16 unalloyed uranium pins of 0·456 in. dia, each clad with stainless steel tubes 0·484 in. dia and 0·010 in. wall thickness, the space between the uranium and its tube being filled with sodium and inert gas, space being left in the top of the tube for uranium growth.

Radial blanket elements have 0·415 in. pins with a tube diameter of 0·443 in. The total length is 72·25 in. with approximately 5 in. space left for inert gas and sodium.

5. Reactor vessel
2 in. thick stainless steel.

6. Main reactor container
Cylindrical, 72 ft dia and 120 ft high with a hemispherical top and ellipsoidal bottom. Plate of 1·03 in. thickness, and 0·52 in. for top dome. No field stress relieving will be carried out. Biological shield of concrete is 7 ft thick.

7. Coolant
Sodium for primary and secondary circuit. Some 90% flows through the core assembly with velocity of 30 ft/sec and 7% through the radial blanket channels at lower velocity. The remaining 3% is distributed to the control rods.

Inlet temperature	552° F
Outlet temperature	802° F (Average)
Temperature rise	250° F
Outlet temperature	995° F (Max)

Friction pressure loss 42 psi

8. Control rods
   Eight safety rods and two shim rods, all of boron carbide enriched with boron-10. Safety rods about 31 in. long. The shim rods 8 in. long move at the relatively low speed of 9 in./min.
9. Heat exchangers
   Three primary and three secondary, both of the shell and tube type.
10. Sodium pumps
    Both primary and secondary circuits have pumps of the centrifugal type, with shaft sealing by inert gas.
    There are check valves on the discharge lines of each pump to prevent return flow in case of a pump failure.
11. Steam conditions
    (a) Initially
    600 psia, 755° F, 1,015,000 lb/hr
    Final feed temperature 400° F
    (b) after two years in operation
    900 psia, 820° F, 1,470,000 lb/hr
    Final feed temperature 430° F

Provision is made for dumping two-thirds of the heat output while maintaining normal feed water conditions so that the reactor can be operated before the turbine is installed or when the turbine is shut down. This will be carried out by the main condenser and provision has been made to limit the exhaust steam temperature to 200° F. This is accomplished by first passing the steam through the de-aerating water storage, thus desuperheating it to the saturated temperature of 340° F and then cooling it by condensate from the hot well to 200° F.

12. Turbine
    156 MW, by Allis Chalmers Manufacturing Company.

10. Comparison of particulars and design data

This essential information is summarized in detail for three pressurized, one boiling light water and one

Table XIII.—PARTICULARS OF FISSILE MATERIALS AND DIMENSIONS OF REACTOR CORES FOR NUCLEAR POWER STATIONS IN U.S.A.

1	2	3	4	5	6	7	8
	Nuclear Power station	Unit	Shippingport	Yankee (Rowe)	Indian Point	Dresden	E. Fermi
1	Heat rating of reactor	MW(H)	232	392	585	624·2	300/430
2	Type of reactor	—	PWR	PWR	PWR	DPBR	FBR
3	Fissile material	—	90% U235 and UO_2	UO_2	UO_2	UO_2 and ThO_2	U235
4	Weight of 90% U235	kg	75	—	—	—	—
5	Weight of enriched U235	tonne	—	—	—	—	2·1
6	Weight of UO_2	tonne	14·2	22·7	0·275	60·0	—
7	Weight of ThO_2	tonne	—	—	8·275	—	—
8	Total weight of UO_2 and ThO_2	tonne	—	—	8·550	—	—
9	Ratio of weight of UO_2/ThO_2	—	—	—	30·06	—	—
10	Enrichment (atoms %)	%	90% U235	3·02/2·29	90% U235	1·5	20
11	Average fuel temperature	°F	1000	—	—	—	—
12	Maximum fuel temperature	°F	3800	4700	—	2800	1300
13	Life of fuel	hr	8000	10.066	15,840	4320	—
14	Burn-up	MWD/tonne	3000	8208	—	5000	—
15	Diameter of core	in.	72	75	78	120	31
16	Height of core	in.	72	90	96	108	31

Table XIV.—PARTICULARS AND DIMENSIONS OF FUEL ELEMENTS AND ASSEMBLIES AND CONTROL RODS (PRESSURIZED AND BOILING LIGHT WATER REACTORS)

1	2	3	4	5	6	7	8
	Nuclear power station	Unit	Shippingport		Yankee (Rowe)	Indian Point	Dresden
1	Type of fuel element	—	plate	rod	rod	rod	rod
2	Number of assemblies	—	32	113	76	120	700
3	Number of bundles per assembly	—	60	7	305/306	—	—
4	Number of elements per bundles	—	—	120	—	206	—
5	Total number of fuel elements	—	1920	94,920	23,218	24,720	17,500
6	Width of plate fuel elements	in.	2·05	—	—	—	—
7	Thickness of plate fuel elements	in.	0·039	—	—	—	—
8	Length of plate fuel elements	in.	70·75	—	—	—	—
9	Number of pellets per fuel rod	—	—	26	150	—	—
10	Diameter of pellets	in.	—	0·3575	0·290	—	—
11	Height of pellets	in.	—	0·3494	0·60	—	—
12	Outside diameter of fuel rods	in.	—	0·4110	—	0·3125	0·500
13	Overall length of fuel rods	in.	—	10·25	90	—	112
14	Lattice centre distance of fuel rods	in.	—	—	0·425	0·3805	0·75
15	Outside diameter of tubes for fuel rods	in.	—	0·420	0·337	—	—
16	Nominal thickness of tubes	in.	—	0·028	0·021	0·020	—
17	Design pressure for tubes	psi	—	2500	2500	1800	—
18	Cold hydrostatic test pressure for tubes	psi	—	5000	3750	—	—
19	Material for tubes	—	—	zircaloy–2	stainless steel	stainless steel	stainless stee
20	Total length of fuel assemblies	in.	—	—	120·75	135·375	—
21	Cross section of each assembly	in.	—	5·6 square	7·61 square	5·775 square	3·75 square
22	Thickness of fuel assembly cladding	in.	—	0·0225	—	0·180	—
23	Material of fuel assembly cladding	in.	—	zircaloy–2	—	zircaloy–2	zircaloy–2
24	Number of control rods	—	—	24	24	—	—
25	Length of control rods	in.	—	71·5	—	—	—
26	Number of control shims	—	—	—	8	21	90
27	Width of shims	in.	—	—	—	7·5	3
28	Thickness of shims	in.	—	—	—	0·3125	0·375
29	Length of shims	in.	—	—	—	—	113
30	Material of control and shims	—	—	hafnium	silver alloy	hafnium	silver alloy

sodium-cooled fast breeder reactors in the following tables:

		Table
(a)	Fissile materials and dimensions of reactor cores	XIII
(b)	Fuel elements and assemblies, and control rods for pressurized and boiling light water reactors	XIV
(c)	Fuel elements and assemblies for Fermi reactor	XV
(d)	Reactor vessels	XVI
(e)	Containment vessels	XVII
(f)	Turbines and condensers	XVIII

11. Characteristic features of the steam turbine for the nuclear power station at Dresden, Illinois.

This three cylinder, single shaft turbine of 192 MW

Table XV.—PARTICULARS AND DIMENSIONS OF FUEL ELEMENTS AND ASSEMBLIES FOR THE E. FERMI NUCLEAR POWER STATION

1	2	3	4	5	6
		Unit	Centre core	Blankets	
				Axial	Radial
1	Number of fuel assemblies	—	91	182	572
2	Number of rods per assembly ...	—	144	16	25
3	Total number of rods per section ...	—	13,104	2912	14,300
4	Outside diameter of fuel rod ...	in.	0·148	0·415	0·415
5	Inside diameter of cladding ...	in.	0·148	0·423	0·423
6	Outside diameter of cladding ...	in.	0·158	0·344	0·443
7	Thickness of cladding...	in.	0·005	0·010	0·010
8	Sodium bond thickness	in.	—	0·004	0·004
9	Diameter of axial blanket	in.	—	30·5	—
10	Inside diameter of radial blanket ...	in.	—	—	30·5
11	Outside diameter of radial blanket ...	in.	—	—	78·5
12	Length	in.	—	14·0	65·0

Table XVI.—PARTICULARS OF REACTOR VESSELS

1	2	3	4	5	6	7	8
	Nuclear power station	Unit	Shippingport	Yankee (Rowe)	Indian Point	Dresden	E. Fermi
1	Heat rating of reactor	MW(H)	232	392	585	624·2	300/430
2	Type of reactor	—	PWR	PWR	PWR	DPBR	FBR
3	Shape of vessel	—	Cylinder	Sphere	Cylinder	Cylinder	Cylinder
4	Diameter	ft	9	9	9·75	12	14·5
5	Overall height	ft	33	—	40	42	36·3
6	Thickness of material	in.	8·5	8·0	—	5¼	2·0
7	Thickness of hemispherical end	in.	10·0	—	—	—	—
8	Thickness of internal cladding	in.	0·25	—	0·109	—	—
9	Material for cylinder or sphere...	—	carbon steel	carbon steel	carbon steel	carbon steel	stainless steel
10	Material of internal cladding	—	stainless steel	stainless steel	stainless steel	stainless steel	—
11	Operating pressure (internal)	psi	2000	2000	1500	1000	90
12	Design pressure (internal)	psi	2500	2500	1800	1200	120
13	Hydrostatic test pressure	psi	3750	—	—	—	—
14	Reactor temperature (average)	°F	542	535	500	480	802
15	Number of openings for coolant (inlet/outlet)	—	4/4	4/4	4/4	4/12	—
16	Minimum inside diameter of openings (inlet/outlet)	in.	15/15	—	20½/20½	24/16	—
17	Weight of reactor vessel (a) dry ...	ton	250	—	—	—	—
	(b) including fuel and coolant	ton	—	—	—	580	340

Table XVII.—PARTICULARS OF CONTAINMENT VESSELS

1	2	3	4	5	6	7	8
	Nuclear power station	Unit	Shippingport	Yankee (Rowe)	Indian Point	Dresden	E. Fermi
1	Heat rating of reactor	MW(H)	232	392	585	624·2	300/430
2	Type of reactor	—	PWR	PWR	PWR	DPBR	FBR
3	Shape of vessel	—	Cylinder	Sphere	Sphere	Sphere	Cylinder
4	Diameter	ft	38	125	160	190	72
5	Length	ft	—	—	—	—	120
6	Thickness	in.	1·25/0·66	0·875	0·875	1·75/1·375	1·03/0·52
7	Design pressure	psi	52·8	34·5	27·5	29·5	—
8	Test pressure	psi	70	43·2	34·5	37·0	—
9	Material	—	Carbon steel	Carbon steel	Carbon steel	—	Carbon steel
10	Thickness of biological shield (concrete) ...	ft	3·5/5	—	6	7	7

Table XVIII.—PARTICULARS OF TURBINES AND CONDENSERS

1	2	3	4	5	6	7	8
	Nuclear power station	Unit	Shippingport	Yankee (Rowe)	Indian Point	Dresden	E. Fermi
1	Heat rating of reactor	MW(H)	232	392	585	624·2	300/430
2	Type of reactor	—	PWR	PWR	PWR	DPBR	FBR
3	Rating of turbogenerator	MW(E)	79·273	145	275	192	156
4	Speed of turbogenerator	rpm	1800	1800	1800	1800	1800
5	Number of shafts	—	1	1	1	1	1
6	Number of cylinders	—	1	3	3	3	3
7	Number of exhausts	—	1	2	2	2	2
8	H.P. pressure at T.St.V....	psig	605	450·3	355·3	950·3	885·3
9	H.P. temperature at T.St.V.	°F	489·8	460	1000	540	820
10	H.P. steam flow	lb/hr	987,350	1,840,000	2,200,000	1,407,000	1,470,000
11	State of H.P. steam at T.St.V.	—	saturated	saturated	superheated	saturated	superheated
12	L.P. pressure at T.St.V.	psig	—	—	—	460·3	—
13	L.P. temperature at T.St.V.	°F	—	—	—	539	—
14	L.P. steam flow	lb/hr	—	—	—	1,187,660	—
15	State of L.P. steam at T.St.V.	—	—	—	—	saturated	—
16	Total H.P. and L.P. steam	—	—	—	—	2,595,060	—
17	H.P. steam in per cent of total	%	—	—	—	54·21	—
18	L.P. steam in per cent of total	%	—	—	—	45·79	—
19	Vacuum at turbine exhaust (30 in. Hg barometer)	in. Hg	28·5	—	28·5	27·5	—
20	Final feed temperature	°F	325	—	332	405	430
21	Number of feed heating stages	—	3	—	4	5	—
22	Wetness at turbine exhaust	%	13·2	—	5·9	—	—
23	Turbine heat consumption	btu/kWh	11,272	—	—	—	—
24	Turbine thermal efficiency	%	30·28	—	—	—	—
25	Net station heat consumption	btu/kWh	12,830	—	10,700	11,893	—
26	Net station thermal efficiency	%	26·6	—	31·91	28·7	—
27	Steam to the condenser	lb/hr	695,190	—	1,525,000	—	—
28	Surface of the condenser	sq ft	70,000	—	212,000	—	—

at 1800 rpm, designed to operate on the dual pressure steam cycle, has the following novel features:

(a) Moisture separating device at each extraction point, at the last stage of the high and intermediate sections.

(b) Pressure control governor on the primary admission and by-pass valves for by-passing around the turbine to the condenser.

(c) Load control governor on the secondary admission valves.

(d) Special seal for the shaft when operating on the turning gear so that the turbine may be filled with water and decontaminating fluid prior to maintenance.

(e) Particular attention was given to the elimination of pockets or crevices in which radio-active material may lodge.

(f) Turbine by-pass valves provide a safety relief system for the reactor, through which some of the steam can be pumped through reducing orifices and the desuperheater to the condenser.

(g) These orifices are of multiplate design and the steam flowing through them exhausts into eight discharge pipes ranging from 30 in. to 42 in. dia.

(h) Condenser designed so that about half the by-passed steam can be exhausted into the side of the condenser and the other half into the distance piece between the turbine and the condenser. This method reduces considerably the height of the turbine foundation.

(i) Condenser also protected by relief diaphragms which exhaust above the roof of the turbine building.

(j) Failure of the by-pass valves or closure of the sphere isolation valves brings into operation another full set of safety valves which are connected to the primary system and are located inside the sphere.

(k) Turbine is supplied with HP and LP steam from the boiling light water reactor, the high pressure at the turbine stop valves being 950·3 psig which, so far, is the highest steam pressure obtained from a reactor. However, the temperature is only 540° F, which corresponds to saturation.

(l) A demineralizing plant has been incorporated in the feed water to the reactor in order to eliminate the solids resulting from corrosion.

12. Total capital cost of U.S. nuclear power stations. The following table gives the cost per kW (gross) and per kW (net) for the Yankee and Indian Point stations.

	Generating capacity		Total capital	
	gross	net	per gross	per net
	MW	MW	kW	kW
(a) Yankee	145	134	$345 (£125)	$373 (£135.5)
(b) Indian Point	275	255	$327 (£119)	$353 (£128)

It is of interest to note that the total capital cost of a conventional high pressure and temperature station with re-heating is $225 (£82) per kW (gross) in New York City.

Oil and Natural Gas Reserves of the Producing Countries

Each year the oil industry devotes some 60% of its entire capital expenditure to exploration and production. The value of its sustained endeavours in searching for oil is demonstrated by the fact that, despite a record world production in 1958 of well over 900 million metric tons, at the beginning of the present year proved reserves stood at a higher level than ever before. Whereas at the beginning of 1958 they were estimated at some 35,700 million metric tons, twelve months later the total had swollen to an estimated 37,000 million tons.

By far the most important individual contribution was provided by the Middle East—with resources calculated at almost 24,000 million tons, or more than two-thirds of all world proved supplies. Within this area, the principal quotas came from Kuwait, Saudi Arabia, Persia and Iraq—with each of the first three accounting for reserves greater than those contained within the U.S.A.—now providing nearly 40% of annual world production.

In the U.S.A., despite a lower rate of drilling activity during the year, the industry succeeded in adding materially to its proved reserves of oil and natural gas. The former rose to a new record of 4200 million tons. This is remarkable when it is recalled that during the past century the U.S.A., with no more than a seventh of the world's potential oil-bearing land, has provided more than half of all oil produced.

The other two major oil regions are Latin America and the U.S.S.R. The former claimed proved reserves totalling 3000 million tons, of which more than two thirds are contained within Venezuela. The U.S.S.R. bloc has supplies estimated at 3800 million tons.

Aside from these major regions, there are many countries whose oil resources help to swell the world total. Among them are Indonesia and British Borneo, the Sahara, Canada and the countries of Western Europe.

By far the most important single producing country in the Commonwealth is Canada—which last year provided 22 million tons. This year there are hopes of raising this figure by 10%—though even this will only suffice to restore the level reached in 1957.

In British Borneo the Seria oilfield in Brunei, like the much smaller Miri oilfield in Sarawak, is beginning to enter a period of declining yield. Trinidad, third among the Commonwealth producers, has lately shown a rising output, bringing it approximately on a level with British Borneo.

The remaining Commonwealth countries provide less than a million tons between them. India, now obtaining a few hundred thousand tons, will however soon be supplying substantially more. The U.K., Pakistan and Nigeria—where production commenced in 1958 but where tests are continuing to determine if commercial output can be maintained—are the remaining sources. The U.K. provides about 150,000 tons (including shale oil) annually and Nigeria last year produced double that amount. In Pakistan a slightly higher rate of yield has been achieved, but more important at present are the supplies of natural gas derived from Sui in West Pakistan and Sylhet in East Pakistan.

Management for Sales

The ever-present problem of selling the engineering product has acquired a degree of urgency at the present time. Many aspects of selling were discussed at the Northern Management Conference held at Southport by the British Institute of Management. Cogent points from some of the papers are presented here

The Whole Company as a Sales Organization

Opening address by Kenyon W. Jones, M.B.E.

IN the opening address the speaker began by recalling his early days in business when the chairman of the company he was working for commented rather wryly when sales results were not as brisk as they might have been, "I find when sales are good you have no real problems; when sales are bad then there is nothing but problems".

As experience grows one comes to realise that business is essentially reduceable to a simple operation—or rather a combination of two operations, making something and selling it. Under exceptional conditions—as, for example, obtained in this country in the immediate post-war years—production can be a determining factor in a company's operations but most business men will agree that the success of a business depends upon its ability to sell its products, and its activities should be substantially geared to this end.

Mr. Jones offered three points of view:

Firstly, organization. How can a business best be organized so that its activities are focused on successful selling?

Secondly, personnel. How can we handle the personnel in a company to achieve this same end?

Lastly, "attitude of mind". Having established our organization and having decided our personnel policy, what sort of attitude of mind do we want to instill in our work-people and how do we set about it?

The attitude of mind we are seeking in our organization is the belief in the mind of every employee that the basic end of whatever job he is doing is successfully selling the company's products or services. This can best be done by examining what are the attributes one looks for in a good salesman, i.e. the man whose sole job is to sell and who is occupied with its problems all the time.

Firstly, he has to have a clear objective of what he wants to do. Secondly, he must be imbued with the idea of service—that is, the belief that the organization for which he works and the products which he sells, exist and must be geared to serve the ultimate consumer. Without that attitude, successful and lasting sales are impossible. And thirdly, he must have a belief in the prestige and reputation of his company and of its products, for only with such a belief can he acquire the confidence which is the basis of successful selling.

In addition, there is one facet of the attitude of mind which is not foremost in the thinking of the average salesman but which should certainly be associated with sales in the top echelon of any organization, and that is the idea of profit. When we are thinking of sales, we do mean sales at a profit.

How can we then spread this attitude of mind throughout an organization? How can we make the men at the bench, the men and women in the sales routine or the invoicing department, and most important, the executives and departmental heads of a company, sales, service and profit conscious? That is the crux of our problem.

It is essential to make a plan and to put that plan over, to "put people in the picture" and to tell them what particular part they have to play.

The average business executive tends to be too secretive, or to put it in a more positive way, should take more pains to take the people working for him into his confidence, to explain to them what he is trying to do and to discuss his problems freely with them, and further, to encourage them to take a similar attitude with their own subordinates so that the achievement of the company's aims and the solution of its problems become the responsibility of every employee.

We make a point of at least once a month getting all our senior executives together to discuss marketing problems. The sales and advertising people are, of course, there, since it is their immediate concern, but the production, research and financial people also come along and our marketing problems are freely discussed with them. Our main objective is to formulate our sales objectives, examine those objectives in the detail of their practical application and, of course, to evaluate results, but what we do want to ensure is that those executives of the company not specifically connected with sales fully understand our objectives and problems and can make them part of their own planning when they get back to their own departments.

Let me give one or two concrete examples of what I mean. Firstly, the important business of co-ordinating sales and production, which is a headache in many companies. Success in this field will be far better achieved if production men are in at a very early point of the sales planning. It means that long before you finally resolve what you want to sell and the quantities you expect to sell, your top production people have been able to evaluate roughly what would be expected of them, to advise you of some of the practical problems that are likely to come up, and particularly to advise you on the time factor.

Then research and development. Obviously the scope, skill and method of this vary very greatly from company to company and in some companies there are long-term research projects which are being worked on perhaps years before, as it were, they come to the marketing table, but it is an enormous help to the head research man to hear at first hand from his marketing colleagues, firstly complaints which they are meeting with some existing products and which should be corrected, and secondly what new products the marketing people think they are likely to be needing.

Thirdly, the accounting personnel. And here again I come back to this important matter of profits. It has always seemed to me vital at a very early stage of marketing planning to have at least a rough idea of what the financial implications are. Products which the marketing people think will make admirable additions to your line could be knocked right out of court by a few quick calculations by the chief accountant and a lot of time thereby saved. It has always been a good point, of course, whether the marketing people should be given information on profit margins. Sales executives generally feel that their main concern is volume, and margins and the resultant profits are the concern of the accountant and top management. I just do not accept that point of view. I think every sales executive will do a better job if he has the information as to which of the products he is selling is contributing most to the overall profit of the company, and when he knows that, he will do his best to plan his own operations to secure the maximum profitability.

When executives see the value of freely disseminating information and of stimulating discussion and criticism, then they will adopt the same attitude towards their own staffs so that gradually this attitude of mind permeates through an organization.

Planning the Sales Effort

By P. Randolph, Joint Managing Director, Wilkinson Sword Limited

TIME and money spent on surveys and the obtaining of information will seldom be wasted: indeed the maintenance of a perpetual survey will be found worth while by most companies. Such a survey would mean the examination of all new patents in the field of operation or potential operation of the company; a full press cutting service in all spheres of possible interest; market research information about competitors' current products; marketing news of the plans of competitors, such as their proposed advertising plans and intentions on display material and sales aids; and finally surveys of the markets themselves, particularly aimed at discovering trends and taking advantage of them. This perpetual survey must be carried out on a world wide basis if it is to be wholly effective, particularly in the field of product development. Much useful fringe information may be obtained, for instance from the North American market. This survey information may enter the company from many sources; it needs sifting, analysing and presenting. The creation of a department of Sales Intelligence or Sales Research may be found well worth while as a means of relieving sales management and top management of much cross-questioning, as well as providing an excellent training ground for the young potential divisional sales manager.

The place of the sales department in product design has been questioned many times in the past. As a general proposition it could be postulated that the less the sales department has to do with product design, the more sales effort they will need to sell it. A company in which the design staff go along to sales management periodically and ask them whether the latest prototype is likely to sell, is not nowadays satisfactory. In general, better results are likely to result from official discussions whether minuted or not, under the chairmanship of a director, in which design, development, sales and production departments are involved, together with a consultant designer if one is employed.

Having decided what is to be sold, and knowing all the relevant information about the market in which it is to be sold, the wise manager will give careful consideration to its method of distribution. Many distribution systems are antiquated and more suitable for the bargaining system in an Eastern market place than for an industrial complex upon which depends the economies of many nations and millions of individuals.

Of the methods of distribution that give a satisfactory balance between low cost and marketing control the first is where the product factory or company runs its own chain of retail shops. This course presents less difficulty from a distribution point of view than others, giving the producing factory complete control over all its external activities. But it requires a great deal of capital investment, and is unlikely, except in the ultimate stage of evolution, to allow complete distribution.

The second alternative is where the factory sells to selected retailers. This is one of the most effective that has so far been devised. Many of the pounds sunk in sales effort in the past have been sunk on the rocks of wholesalers who would not co-operate with the marketing plans proposed, selling to retailers who had no contact whatsoever with the product or the sales philosophy of the factory producing it. This method means the main burden of capitalization of stocks and allowance for fluctuations of sales falling on the producing factory.

The third preferred method will work excellently if it is carried out correctly. In this the wholesaler must be fully approved, indeed be probably a contract wholesaler who is obliged to carry out the policy of the selling factory. The wholesaler in turn will deal only with approved outlets. In this way it is possible to create the right marketing arrangements for market research, point of sales displays, sales statistics, etc.

Obviously these remarks apply to consumer branded goods, though it will be good for a sales management selling any kind of product, or a service, to review their distribution processes periodically.

When objectives have been settled and channels of distribution arranged, the sales management must relate the sales effort required to sales expenditure and must review budgets and forecasts of likely statistics. To deal with the latter first, one can lay down some simple rules:

State the object of the forecast as precisely as possible.

State the terms in which the forecast is expressed, i.e. lbs, inches, consumer selling prices, landed costs, etc.

Assemble all the facts, not just those which agree with the case being presented.

Discard unimportant facts, not just those which disagree with the case being presented.

State the degree of reliability of the forecast at each step.

Embark on hunches: say why.

Look at the whole forecast again and see whether it follows a likely overall trend.

Budgeting is already important to most industrial business: its importance in planning and controlling sales expenditure may be vastly more important than in other parts of the company. Much sales expenditure is intangible: it is possible that with the extension of inter-firm comparison we may be able to create yardsticks which will help us decide an economic volume of sales effort for a particular objective. For the moment sales management must content themselves with the fruits of wisdom and experience, but there are some pointers for the sales manager which will help him in his decisions.

Firstly, what are the living standards of his employees compared with employees of comparable rank? How do they compare with the sales employees of his immediate competitors whom they meet at conventions, conferences and the rest? Secondly, how much expense is devoted to travelling and how much to selling? The first approach to this may be statistical, but in the departmental budgets the analysis of the way the time of sales force is spent will be most illuminating and will help with effective sales planning for the future.

Thirdly, how is advertising expenditure decided and controlled and what proportion does it form of the total sales budget; and of the total company expense budget? Larger companies are increasingly revealing their turnover and from advertising figures already obtainable, it is obvious that many companies will have to spend much more on advertising than they are now doing if they are going to survive, and certainly if they are going to expand.

Organization for Distribution

By J. L. Hepworth

IN the successful marketing of the vast majority of goods, one of the key factors is that of distribution. It is necessary first to decide who is the final consumer of the product, what is the most convenient place for him to purchase, and in what form. Thus in the case of domestic products the housewife may purchase from the local shops, and also from multiple stores in big centres. In the case of motor car spares the owner of the vehicle may appear to be the consumer, but in fact the man whose duty it is to fit the part to the motor car is the real one to consider; in most cases he will be the garageman, and he will probably draw his supplies from a local wholesale factor. In the case of heavy machinery it is likely that the final consumer is another factory who would purchase direct from the manufacturing company and not from any intermediary.

The author's own experience has been in connection with motor car and vehicle spare parts where immediate delivery is absolutely vital. The consumer, the garage man or engine repairer, is seldom prepared to carry in his own stores more than a limited number of components for the more popular vehicles, and expects to have delivered to him in a matter of hours, components for any other type of vehicle which enters his workshop.

This demand for rapid service has built up a rather long distribution chain from factory to consumer in order to provide an off-the-shelf service, for whilst the factory may be able to deliver all the necessary items out of its own stock the consumer will not wait for the transit time. Thus a typical distribution arrangement to give the maximum coverage is as follows:

(a) A small stock of all popular items is available in every sizeable town and held by small wholesalers, or in some cases by a larger engine reconditioner.
(b) A larger and more comprehensive range of stock is held at strategic points to give less than a 24 hr service to the smaller wholesalers in the area.
(c) The factory warehouse "buffer stock" giving full coverage of the product.

Distribution by such a chain necessitates a firm trading policy as regards discounts structure, for each link in the chain must have its dues. There are, no doubt, many temptations at times to short-circuit and deal direct with the consumer, either in an effort to reduce the final selling price or increase the profit margin for the factory. In the case of certain kinds of products this long chain of distribution may be undesirable, but in many cases it is the only way of giving the necessary local service to the trade.

Much has been heard about packaging of goods in such a way that they are both adequately protected and attractively presented. An equally important angle is to package the goods in a form which entails the minimum labour in handling all along the distribution chain.

In the case of motor car parts the same thing has long applied. If you are going to decarbonize an engine you need a lot of new gaskets, and were you to do this yourself in your own garage you may be at a loss to find out just which gaskets you need; if you go to the local wholesale factor and let him know the make and model of your car it is more than likely that he can sell you a nicely presented pack containing all the gaskets you will need.

Furthermore, if you decide to strip an engine down to do a complete repair he could sell you an alternative and larger pack of gaskets for this purpose. If you want new pistons you will probably be sold a carton containing an engine set of pistons (i.e. four in the case of a four cylinder engine) which already have their gudgeon pins selectively fitted, and which also have the piston rings in their grooves already gapped for the cylinder. All you need do is take them out of the box and put them straight on to the connecting rods.

Good packaging is expensive, but if well designed acts as a sales aid, saves time and paper work, and avoids customer complaints.

The size of stock for giving the type of service referred to is naturally one of compromise. On the one side there is the sales department demanding that every item and size shown in the catalogue should be immediately available out of stock, whereas on the other hand the company's accountants are pulling the other way with a view to reducing the amount of capital tied up in stock. The target of good stock control is, therefore, to try to satisfy both these opposing forces and in the author's case the target is 90% availability with a stock turnover three times per year.

When stock is maintained by outside purchases, then the "two bin" system would appear to be one of the most advantageous; on the other hand when stock is maintained by the factory the constant re-order cycle has the advantage of promoting more easily adjustments in batch sizes to meet factory capacity.

A considerable saving in time and money can be had if the customer can be persuaded to state his requirements clearly and concisely in the form of a simple code or reference number. This presupposes that a comprehensive and clear catalogue has been issued and the customer's order clerk taught how to use it.

In our own warehouse it has been found convenient to have two separate despatch sections, one to deal with the home market and one to deal with exports. The towed trucks containing goods ordered are sent through to the despatch sections, and in the case of the home despatch there are three possible ways of dealing with them. Post orders, usually for relatively small consignments are diverted down one packing bench when they are wrapped, labelled, weighed and put into the post bag. Goods which are to go by normal inland transport pass to a packing section, working alongside a roller track. Where the method of transport is one which delivers the goods straight to the customer's door

the various cartons are packed in very light and cheap cardboard cases, frequently second-hand soap or tea cartons, but if British Transport is used and the goods have to be transhipped from one vehicle to another it has been necessary to use stout wooden cases which are well filled with packing material so that the goods inside can stand up to being dropped. Such cases are returnable, and this involves a good deal of clerical work keeping track of the cases with the customers. It will be appreciated that this form of transport is avoided wherever possible.

Packing, warehousing and despatch of goods must be treated as an extension of the production line, and efforts to cut down unnecessary operations and to reduce handling time are just as important at the end of the line as at the beginning. The operating costs of the warehouse should be watched in exactly the same way as a production department, and the modern system of budgetary control is to be strongly recommended. In our own case a four-weekly statement is issued by the cost office showing the budgetted cost and actual cost in this period for each section.

Combined Plate Levelling and Bending

Levelling mild steel plates 10 ft 6 in. wide from $\frac{3}{8}$ to $1\frac{1}{8}$ in. thick and 9 ft wide up to $1\frac{1}{2}$ in. thick is the primary function of the Bronx five-roll levelling machine but the roll arrangement is such that plates up to $\frac{3}{4}$ in. thick may be swept up through 180° on a pyramid roll set-up.

The machine comprises two driven bottom rolls with double support rolls and three upper idle rolls, the centre roll having double support rolls, the two outer straightening rolls being non-supported. The two bottom and centre upper rolls are 14 in. dia and the top outer rolls 15 in. dia disposed at closely nested centres giving the highest efficiency for levelling plates within the range given above. The rolls in the upper bank are adjustable for levelling and bending settings, the two outer rolls being provided with individual adjustments to control the levelling of the plate as it leaves the rolls.

When the machine is employed for plate bending the two outer top rolls are raised to clear the curvature of the plate, leaving the centre backed-up roll to work in conjunction with the two lower rolls in the manner of a pyramid bending machine, as shown in Fig. 1. The limiting radius to clear the outer rolls is 1 ft $11\frac{3}{4}$ in. not exceeding half of a complete circle, and the upper bank is provided with a high lift to facilitate the removal of finished work.

All back-up rolls are mounted in roller bearings to reduce power consumption and the three upper rolls adjusted with screws at each end of the machine are geared together so that the complete assembly can be raised and lowered from one 25 hp motor and reversing controller. Separately the two outer top rolls can be adjusted by means of two 10 hp motors and reversing controllers. The main drive is taken from a 50 hp slip ring reversing motor, 720 rpm with a reversing tramway type controller gear. The machine weighing 56 ton is built by The Bronx Engineering Company Limited, Lye, near Stourbridge, and has a working speed of approximately 15 fpm.

Large graduated enamel dials are provided to show roll settings.

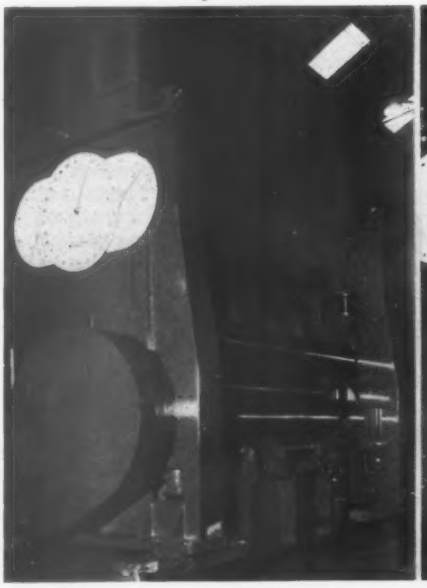


Fig. 1.—(left) The two outer top rolls raised clear leaving the centre backed-up roll to work in a pyramid set-up for plate bending. Fig. 2.—(right) The normal set-up of five rolls for levelling plates $\frac{3}{4}$ to $1\frac{1}{8}$ in. and $1\frac{1}{2}$ in. thick depending on size

The triple tampers are available in two sizes, Model 487 weighing 185 lb and a lighter version Model 387 weighing 118 lb

Triple Tampers for Backfilling

A new design of mounting for the Consolidated Pneumatic triple tampers not only improves the handling of the machine but can be fitted with either the CP-4 ring valve tampers or with No. 3 Simplate rammers, thus giving a choice of weights. These tools for solid compaction on all classes of refilling operations are robustly constructed and designed for ease of handling with very simple control.

The Model 487 is fitted with CP-4 tampers and is a powerful machine for heavy duty operation, weighing 185 lb and working at a 6 in. stroke at a frequency of 750 blows per min. Air consumption is 117 cfm at 100 psi.

The lighter version is the Model 387 fitted with the No. 3 Simplate rammers of $1\frac{7}{8}$ bore and 6 in. stroke. The total weight of this unit is 118 lb. The makers are the Consolidated Pneumatic Tool Company Limited, 232 Dawes Road, London, SW6.

Vacuum Melting Plant

The vacuum melting plant at the works of William Jessop & Sons Limited which was described in our March, 1958, issue has acquired new plant and is now the largest operational vacuum melting plant outside America. Vacuum melting is essential for the manufacture of titanium and zirconium but it has been found greatly to augment the physical properties of high duty steels

THE two methods adopted by Jessops for vacuum melting were the consumable electrode arc melting process and the high frequency induction melting process. The new Heraeus consumable arc melting furnace now installed and fully operational is capable of melting titanium ingots up to 24 in. dia and in excess of 2½ tons in weight. Also recently installed and fully operational is a new 600 lb Wild Barfield/NRC high frequency induction melting furnace.

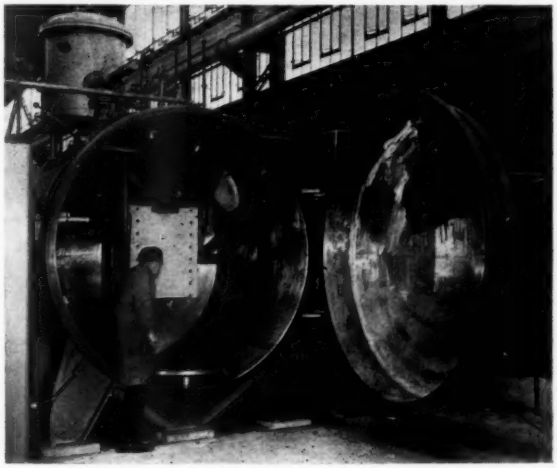
Vacuum melting will not satisfy all the demands of the engineer made on the metallurgist but it does represent a considerable advance in many metallurgical problems. Turbine and compressor disc materials used in gas turbine aircraft engines must be virtually free from non-metallic inclusions. Vacuum melting can ensure this and also provide the designer with enlarged scope for even more highly stressed conditions. This freedom from non-metallic inclusions also ensures that the transverse ductibility of forged discs is improved. Tensile tests on vacuum melted 12% chromium steel discs have, for instance, given elongation values four times greater than those obtained on discs made from air melted material.

In ball bearing and ball race steels it is particularly important that there is freedom from non-metallic inclusions which might give rise to premature failure. Jessops have concentrated much effort in this direction and their vacuum melted ball race steels with extremely high standards of cleanness are now being widely tested.

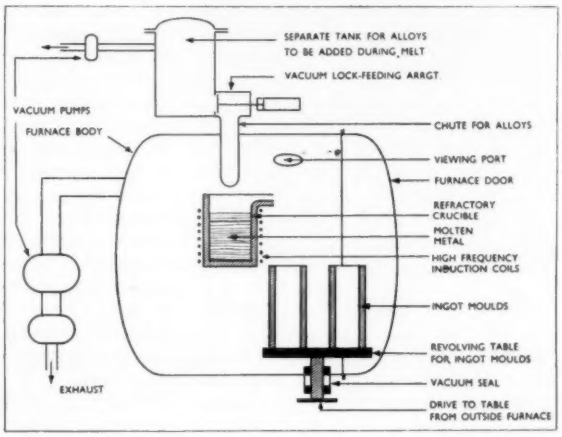
Vacuum melting reduces the total gas content of the metal. Tests have shown that with air melted steel, remelting in vacuum reduces the total oxygen, hydrogen and nitrogen content of the steel from 600 to 200 parts per million. This feature of the process is particularly useful in the production of stock for precision castings or for remelting prior to precision casting for in this way the undesirable blow holes and gas pockets can be obviated. The production of certain steels with low hydrogen content minimises the need for long immunization heat treatment necessary to avoid the danger of hair line cracking.

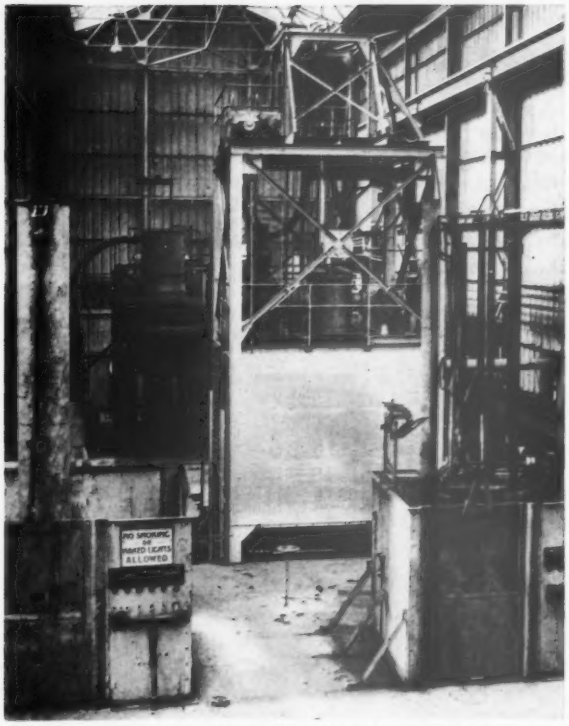
Induction vacuum melting has made possible the production of alloys which because they contained elements which readily oxidized could not be produced by conventional air melting methods. This new technique opens up fresh fields in the development of high temperature materials. One such alloy, Jessop G 64, contains high percentages of aluminium and titanium and can only be made satisfactorily in a vacuum melting furnace. It has excellent high temperature properties and is being assessed for stator and turbine blade applications.

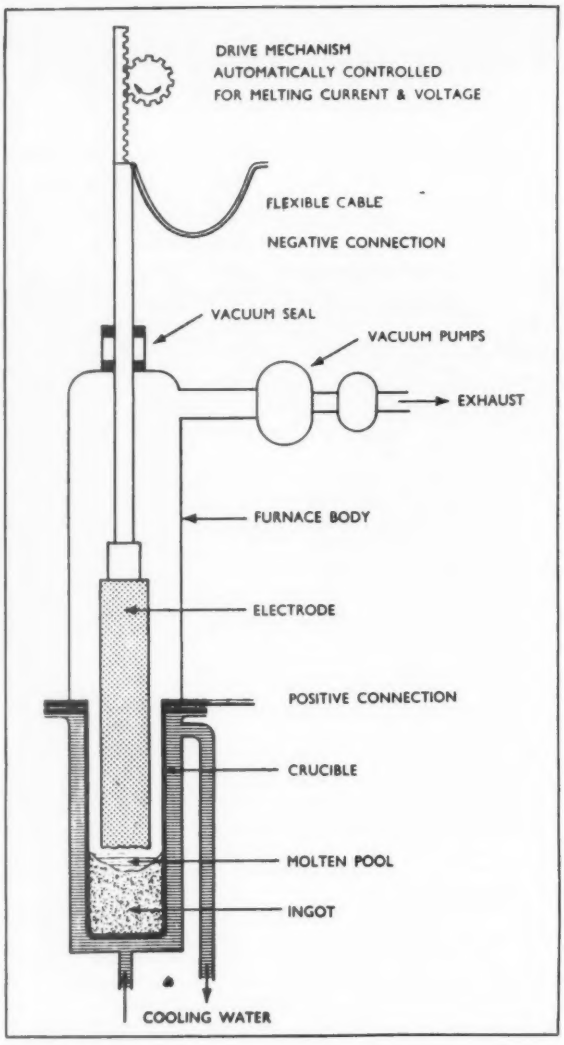
The advent of nuclear power plants has posed further problems for the metallurgist in the demand for new materials. One of these is zirconium which can only be produced by vacuum melting. Jessops are developing a range of zirconium alloys some of which are already in commercial production. In many nuclear applications it is essential that certain tracer elements in steel be reduced to an absolute minimum. The vacuum melting technique permits close control of the chemical composition of every melt and enables certain elements to be



The 600 lb Wild Barfield/N.R.C. high frequency vacuum induction melting furnace and (below) its schematic arrangement







Heraeus consumable arc melting furnace and (right) its schematic arrangement

completely removed and others kept to the specified minimum.

Vacuum induction melting unit

This Wild Barfield/NRC unit is designed for semi-continuous operation, provision being made to accommodate sufficient ingot moulds for several heats on the rotary mould table, and for charging the furnace through a bulk charging hopper without breaking the vacuum in the melting chamber.

The principal component of this installation is a horizontal vacuum chamber constructed of stainless steel approximately 7½ ft dia by 9 ft long. The end of this chamber is sealed by a hinged door and the whole of the chamber and door is water cooled by copper coils, brazed to the outside. This chamber contains the high frequency induction melting coil which is designed to tilt about the pouring axis, and immediately in front of and below the furnace there is a rotary mould table which allows several ingot moulds or castings to be poured from one melt. Provision is made for the observation of all stages of the process through three observation windows, each equipped with shields and wipers.

External controls are provided for the following operations:

(1) Bridge breaker for breaking top layer of unmelted metal in the crucible
(2) Immersion thermocouple pyrometer for temperature measurement
(3) Sampling device which can be extracted through an air lock without breaking the main tank vacuum for compositional control during melting
(4) Sighting tube for optical pyrometer readings
(5) Internal light assembly for illumination of the tank interior.

A cylindrical chamber on top of the horizontal melting chamber contains the alloy charging mechanism, consisting of a 2200 cu in. bulk charging hopper, holding 300 lb of material, and four smaller hoppers each of 90 cu in. and holding a further 12 lb of alloys each. Both bulk charge and alloys are delivered to the crucible by a vibrating feeder through a 6 in. diameter vacuum lock. Alloy buckets are individually tripped by solenoids operated from the control panel. The vibrator feeds into a chute which swings over the crucible and an interlock is provided which prevents the vibrator from operating unless the chute is in position. The whole of this chamber may be refilled without breaking the vacuum in the main tank by closing the 6 in. dia vacuum lock. A special pumping line is provided to evacuate this chamber after it has been recharged with material.

The pumping system is designed to handle the gases from the 600 lb molten charge during melting, purifying and alloying, and pneumatic operation is provided for all the vacuum valves. The vacuum system consists of a 16 in. dia high vacuum manifold and a 6 in. dia rough pumping line connected to the end face of the melting

chamber to enable rapid and complete evacuation of the chamber. This combined system will pump the furnace chamber from atmospheric pressure to a pressure of one micron Hg in 15 min. Vacuum gauges measure the furnace tank pressure from 1 micron Hg to atmospheric pressure. The vacuum instruments consist of one alphatron gauge and a five-point thermocouple vacuum gauge.

Operating platforms are provided for easy access to the controls and observation windows. The control panel for electrical and pumping systems are mounted on the main operation platform. The power supply for the melting is a 200 kW motor alternator set working at 400 volts and 3000 cycles per second.

The furnace will be used for melting iron, nickel and cobalt base alloys.

Heraeus consumable arc furnace

The melting furnace consists of a large vacuum tight vessel evacuated by pumps which are capable of handling large volumes of gas at high vacuum. The actual melting is carried out in a copper crucible which forms the lower half of the furnace.

An electrode is placed inside the furnace where it is welded on to the feeder rod, under high vacuum conditions. The electrode can then be driven up or down, to control the melt, by applying drive to the feeder rod. This feeder rod also carries the melting current, through sliding vacuum seals, from the electrical bus-bars down to the electrode.

The melt is started by striking an arc between the bottom of the electrode and a small charge placed at the bottom of the crucible. The heat generated by the arc provides sufficient heat to melt the tip of the electrode. Molten metal sprays down to form a pool which when solidified forms the ingot. As the molten pool is only of small dimensions great care is taken to ensure that melting conditions are kept constant.

A view of the melt is projected on to the melting desk alongside the many electrical instruments so that the melting operator is able to assess the furnace conditions and make any necessary modifications to control the melting to a rigid specification.

The furnace components, pumps, valves, etc., are actuated remotely from a control cabinet. There is provision for automatic operation of all vacuum equipment so that, when the furnace is closed, evacuation is taken through all its stages entirely without supervision. This automatic system also safeguards the vacuum equipment in the event of component failure. For safety, the arc current is interlocked to all operations which, if faulty, could lead to dangerous conditions. A section of the cabinet is given over entirely to indication of possible breakdown so that rapid rectification can be made.

An electrical control unit drives the feeder rod as required by the melt. Arc gaps can be maintained within fine limits when using this unit at maximum sensitivity, and it is possible to apply a current of 18,000 amp to the electrode.

The vacuum equipment is capable of holding melting pressures below one micron. In this pressure range the arc is very stable. There are two pumps fitted for the final evacuation of the furnace, a roots and a booster pump. Their combined speeds are 4000 litres per second for air and 10,000 litres per second for hydrogen.

Titanium ingots range from 9 in. dia weighing from 120 to 420 lb through sizes 12 in, 16 in, 20 in. dia, to 24 in. dia and exceeding 2½ tons in weight. The plant is capable of producing zirconium ingots but it is likely that initial production will be confined to ingots of up to 800 lb. Steel ingots up to approximately 3 tons can also be produced in the same sizes.

Drawings Photoprinted Every Six Seconds

The outstanding feature of the Zephyr photoprinter designed and manufactured by the NIG Manufacturing Company Limited, Holborn, London WC1, is its unique wind-tunnel Cyclonic developer, which enables the Zephyr to produce a print in under six sec, or, for example 2500 separate prints in an eight-hour day. The Cyclone wind-tunnel principle causes vapourized ammonia to be blown at high speed and at pressure directly on to the entire unobstructed surface of the print. This obviates the old perforated metal plate or roller tank ammonia systems, which gave imperfect penetration, and hence could not produce clear prints at high speeds.

The Zephyr photoprinter utilising the Cyclonic developer invented by the NIG Manufacturing Company will print 2,500 full-scale drawings a day

Lubricator with Perspex Sight Feeds

The substitution of metal shrouded Perspex tubes for the conventional sight feed glass has enabled C. C. Wakefield & Co. Limited, 46 Grosvenor Street, London W1, to introduce a new mechanical lubricator known as the DP60 capable of withstanding 2000 psi. To effect weight saving the oil reservoir is of welded steel construction which in an eight-feed lubricator means a saving of as much as 29 lb over the usual cast iron type. A range of sizes provide any number of feeds from 1 to 32, each feed having a separate flushing plunger operating independently of the pump plunger; full flushing feed can therefore be obtained irrespective of the position of the pump plunger and an air vent screw is provided to each feed to disperse air locks should they occur when pumping commences. A Perspex oil level gauge is built into the side of the reservoir.

Wakefield DP 60 8-feed mechanical lubricator

technique

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Readers are invited to contribute items from their own experience in matters relating to design, manufacture and maintenance

Cropping and Forming a U-shaped Strip

Generally the combination of the two operations cropping and forming on a single press tool are limited to simple shapes, usually parts with a shallow set, but there are occasions when a much more severe bend is essential and this is possible despite the complications that frequently arise in making an awkward profile on the punch and die.

The component illustrated in Fig. 1 is produced in bright mild steel for an accounting machine. Each end of which requires some attention in the way of a profile, but the most noticeable feature is the U-bend that eventually leaves a gap of about $\frac{1}{8}$ in. between the two straight portions. A certain amount of spring-back is permissible and this rather simplifies the construction of the tool, so no attempt was made to include a stripper in the upper member. Pushing the bend well down into the die allows the edge of the short leg to catch under the die and so prevents it rising with the punch. A spring-back of only a few thousandths is necessary for this condition and provided no undue wear takes place on the die surface or the lower edge does not become damaged in any way, then this stripping action will take place and the parts can then fall through into a tray beneath the press bed. The strip for the component is guillotined to width and is supplied in lengths and not in reels. The thickness is approximately 0·04 in.

Fig. 2 shows the tool. After the initial stroke a piece falls through the lower bolster at every press stroke. A bolster A with pillars B and C locates the die D. A long groove machined in the top surface of the bolster is a more satisfactory way of locating the die than relying on dowels as the groove gives greater accuracy when finally assembling the various members.

The stripper E is comparatively short and does not extend to the left of the punch and die as the cropped piece must swing upwards as bending takes place; thus to ensure sufficient location for the strip material the stripper and underneath support plate F are extended to prevent undue movement of the material as the strip is pushed forward to the stop pin G. Incidentally, the end of the stripper is bevelled to clear the root of the punch and so allow the stripper to reach as near to the cutting edge as possible.

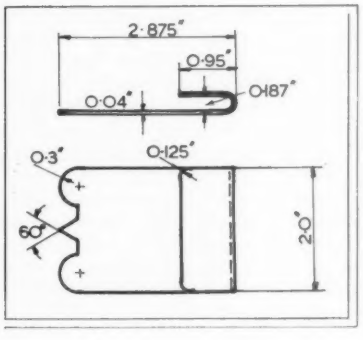
One important feature is the built-up construction of the die. There are three pieces, and though the production of a solid die is feasible, the centre portion where the two long rectangular holes are cut is weak and prone to fracture during heat treatment.

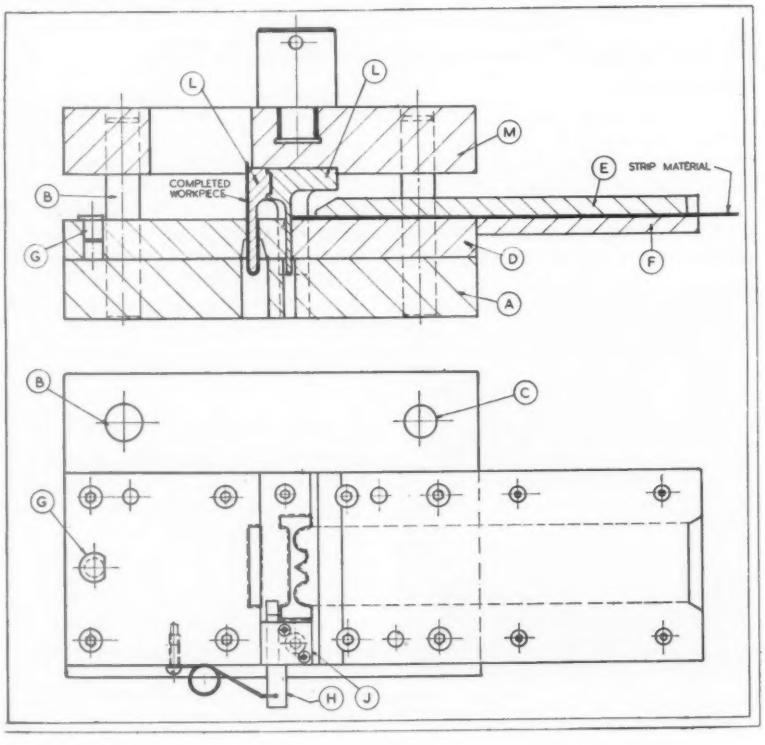
The stop H is fitted in a groove milled and ground in the top of the die with a holding-down plate J to retain it in position. This stop is, of course, the initial setting of the strip and the rough end is trimmed away prior to locating it against the second stop pin.

The upper tool is not elaborate and the chief point of interest is the design of the punches L for cutting the two ends and folding the part in two. A tenon and slot is the only method of obtaining a rigid assembly of the two parts and this is shown in Fig. 2, and the fitting of both in the groove shaped in the bolster will hold them together and overcome any tendency of them to

Fig. 1 (below).—Component for accounting machines. A two stage tool was necessary for economical production

Fig. 2 (right).—Cropping and forming tool





spread while the tool is in action. Fig. 3 is a plan view of the assembly.

In an endeavour to lessen the length of these latter items the top bolster M is cut away to permit the

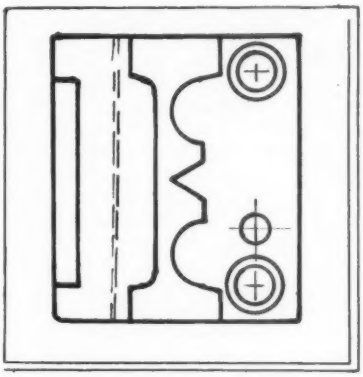


Fig. 3.—Plan view of the two-part punch showing how both are fitted together

workpiece to swing upward while at the same time it begins to sink into the forming die. This cuts a matter of $\frac{1}{2}$ in. or so off the length of the punches and thus keeps them within a reasonable length. Both parts are made practically the same length—the cropping punch must naturally sever the material before bending commences, but a matter of $\frac{1}{64}$ in. is sufficient between the parts; the component is simply 'cracked off' and then immediately pushed through the forming die. In fact the latter dimension is perhaps a little generous and some adjustment to give the best results is possible.

All tools of this nature, where the degree of clearance is at a minimum and the parts are comparatively weak, demand the use of pillars for guiding and the arrangement of these at the rear of a tool keeps the front clear. Finally, in view of the method of stripping the bent part from the forming punch, the clearance between the material and die at that stage needs controlling as the spring-back is merely a matter of a few thousandths of an inch, but if the press ram is set to carry the part down past the ridge in the die the piece should strip easily and without sticking.

Hints on Elevator Belts

While the same general rules are to be observed in installation, inspection and repair of elevator belts as conveyor and transmission belts, The Goodyear Tyre & Rubber Co. (Great Britain) Limited suggest that the following added precautions pertaining only to elevator belts should be observed:

Cemented bucket bolt holes on belts used under wet conditions are desirable.

Avoid more than just enough tension on the foot pulley to make the belt pull without slippage. Provide proper clearance for slack return side to accomplish this.

Inspect bucket bolts frequently, and replace any that may have become loose or broken.

Boot should be kept clean at all times.

Buckets should be at least 1 in. narrower than belt, and preferably, 2 in.

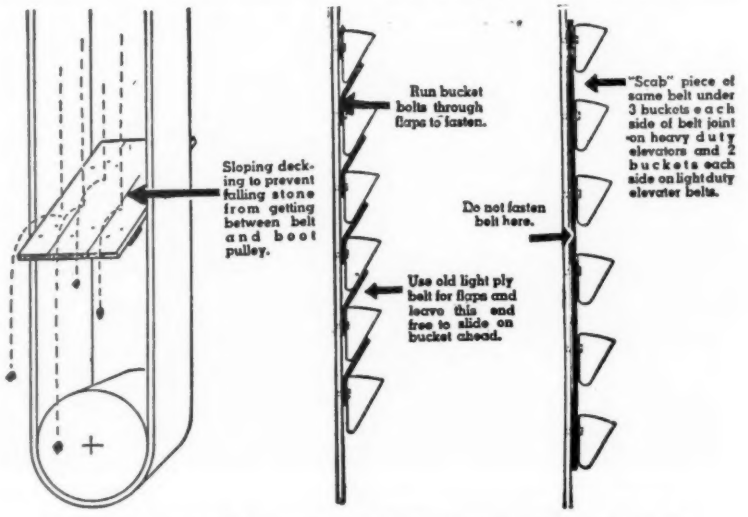
Vulcanized splices should be used wherever possible.

Install sloping decking just above boot pulley to shed any falling material, thus preventing any large particles from falling between boot pulley and belt and punching holes in the belt. Fluted boot pulleys are often desirable to prevent such action.

Flaps made of old transmission or conveyor belts are sometimes useful on continuous-type bucket elevators in keeping material from getting under the buckets as they discharge.

Washers made from old belt under each bucket are recommended for spaced bucket belt elevators handling hot fine materials to protect the belt from heat.

Butt splices as shown in the illustration are recommended.



Protecting the bottom pulley of an elevator from spillage and desirable details of bucket fastenings

Mechanization of a Blending Plant

A system of mechanization for feeding raw materials through the various processes and ultimately to the tin-filling machines is embodied in the new plant of Winthrop Laboratories Limited, an associated company of Scott and Turner Limited, who make Andrews Liver Salts.

The chief ingredients, tartaric acid, sodium bicarbonate, magnesium sulphate and sugar, are laboratory checked on arrival and each elevated by Redler totally-enclosed dust-tight elevators to a battery of circular bins each fitted with a Redler two-stage bin discharger, by the use of which a constant flow-rate is maintained. An important asset is that each storage bin is fitted with a Tidal bin level control which maintains the level of the material in the bin, any over-loading or falling-off in level means that the flow-lines are automatically controlled to maintain a predetermined bin content.

The various ingredients are then fed, as required, by means of skeleton-type chain links within the dust-tight Redler conveyor shafts and are 'flowed' to a series of fully-automatic weighing machines where each ingredient is accurately weighed. The constituents then travel slowly over a set of 'drying decks' where all surface moisture is completely eliminated. The enclosed conveyor lines take the materials to the mixing hoppers after which the blended salts are conveyed to a battery of storage bins equipped with Redler circular

bin dischargers prior to the final filling processes.

In the filling bays, a circuit conveyor system enables the salts to be drawn off from any of the storage hoppers and relayed into the two conveyor circuits which feed the home and export filling machines as required. The conveyor system recirculates any surplus which remains undistributed but will not accept any more load when the line is full.

The filling machines deal with 4 oz. and 8 oz tins for the home trade and the specially printed 8 oz, 4 oz and 2 oz tins for the overseas markets.

The complete system of elevating, conveying, storage and distribution is controlled from a master panel which shows at a glance the state of the various functions in the chain of operations.

Plastic Behaviour of Steel Structures

At the Royal Society's conversazione on May 14 there was an exhibit to illustrate a principle which is leading to great economies in the engineering design of buildings and steel structures generally. It is common experience that a metal behaves in quite a different way to a brittle body. If a force is applied to it which is greater than it can stand elastically, it yields and suffers a permanent deformation, but it remains as strong as before. This is the basic reason for the usefulness of metals in machines and structures—a brittle body may have as high an elastic limit, but once this is exceeded it cracks and is destroyed.

In an introductory note Sir Lawrence Bragg explained how this principle can be used in two ways:

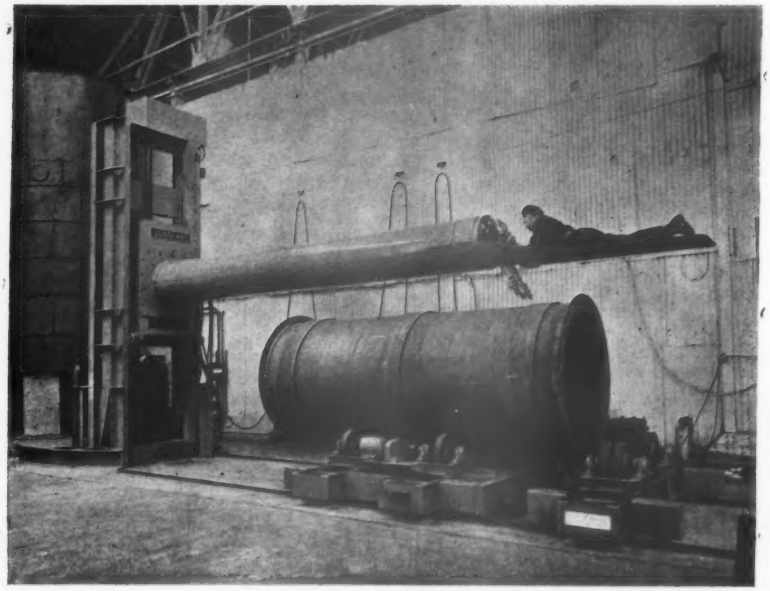
(a) *Designing a structure such as a steel frame building*. If a number of steel members meet at a point, it is impossible to calculate the elastic forces on them all because unknown strains are introduced in forcing them to join up. What happens actually is that the worst-strained member yields slightly, while keeping its strength, and passes on the strain to its neighbours. The next-worst then yields slightly and so on, till all are contributing their best. This is a state of affairs which can be calculated rigorously, and the engineer can confidently design his structures with the minimum amount of steel for the strength required. This is the new principle which Professor Baker has introduced, instead of the old rule of thumb methods, and leads to great economies.

(b) *The Morrison shelters*. They had to be strong enough to stand up to masonry falling on them. They would have to be far too massive if they had to withstand the impact of masonry without yielding. Because they actually yielded, however, they could be made comparatively light.

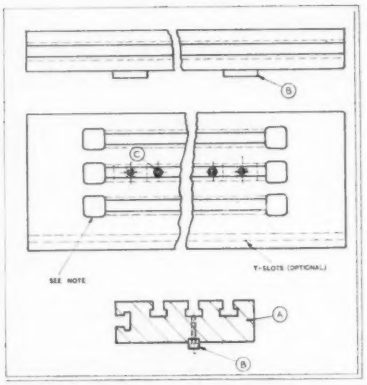
False Table for a Small Milling Machine

The smaller type of milling machine which possesses a single slot running the complete length of the table is not always an easy machine to set because the positions of the clamps are restricted and generally only two are available for holding a component to the table surface, one on each side, and though the miller in question is not expected to undertake deep and heavy cuts, an extra clamp is frequently required just to provide support at one point in order to eliminate some degree of chatter as the cutter runs over a thin section. On such a machine an auxiliary table is very useful.

The tenon slot is utilized for location, and tenons are added to the false table A (see sketch) and spaced as far apart as possible. These are shown at B. Holding down the false table can occasionally present a problem, but by using two T-nuts the tightening of socket headed screws will prevent any movement. If the central slot in the upper table is arranged over the groove machined for the tenon, the counterbored holes for the socket screws C are sunk beneath the bottom surface of the T-slot and therefore do not interfere with the easy passage of the usual clamping bolts back and forth along the slots. Pockets milled at each end of these latter slots give access to the



BOILER WORKS X-RAY PLANT.—This 150 kV Newton Victor X-ray unit with a 360° beam tube has been installed at the Newark Works of the Farrar Boilerworks Limited and is for the radiographic inspection of welded joints on pressure vessels of all kinds. Not long ago the company installed an automatic Fusarc high-lift boom welding machine with CO_2 gasshield



False table located and clamped to the smaller type of horizontal or vertical milling machine greatly adds to the variety of work it can undertake, enabling light operations to be performed on larger workpieces with comparative ease and without overloading the machine. Note—Pocket milled slightly clear and deeper than T-slots to facilitate removal of T-bolts or nuts

slots when assembling the bolts or nuts, and though they are perhaps a little difficult to clean, if the false table is made appreciably longer than the machine table then holes rather than pockets will allow swarf to drop right through.

A side T-slot is added as it is useful for adding a stop for either positioning the components or for restricting the movement of the table.

The two flat surfaces beyond the ends of the slots are useful for small items and the provision of tapped holes for studs is useful. Holes of this nature require grub screws to prevent the swarf from entering and clogging the threads when they are not in use. However, too many of these holes will tend to destroy the flat face and so make the holding of the smaller work difficult.

Because ribbing is not feasible, adequate thickness is essential as a precaution against distortion, and the milling of the three slots together with the tenon groove is preferably carried out prior to a finishing cut being taken over the top and bottom surfaces. Finally, the tapping of a few holes in both end faces is worth considering as the attachment of plates provides stops for the long component when it becomes inconvenient to hold the part in a machine vice.

Centreless Grinding of Drill Bushes

Drill bushes of various sizes are automatically ground on the outer diameter and under the head on Wickman-Scrivener controlled-cycle centreless grinding machines, and the Fig. 1 shows a No. 0 machine of the automatic controlled-cycle type recently installed for this purpose. The machine has a grinding wheel 12 in. dia and control wheel 7 in. dia, the grinding wheel being powered by a 5 hp motor.

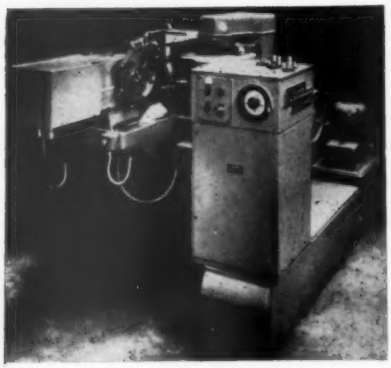


Fig. 1.—Wickman-Scrivener automatic controlled-cycle centreless grinder for drill bushes

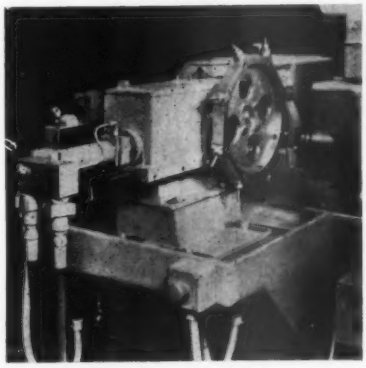


Fig. 2.—Detail of turret and wheels

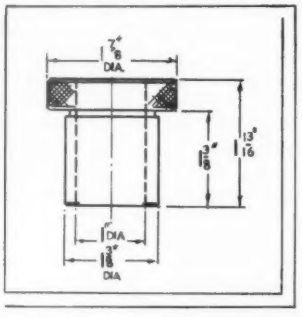


Fig. 4 (right).—Typical drill bush

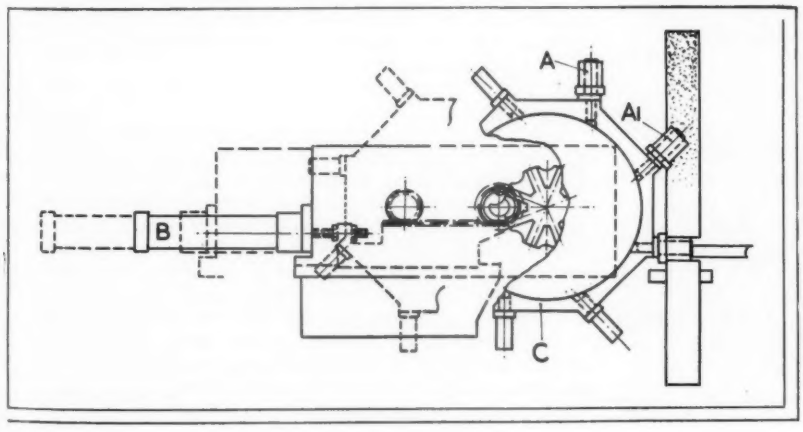


Fig. 3 (below).—Line drawing showing principle of operation

The method employed for automatic feeding is interesting. The workpieces are loaded on to the pins (A, A1, etc.) of a vertical 8-station turret in the manner shown by Fig. 3 when this turret is in the withdrawn position as indicated by the dotted lines and when the wheels of the centreless grinder are open. At the commencement of the cycle, the piston of cylinder B moves the turret C forward (which is static during this movement) to place a piece on the workplate between the wheels of the machine. Under the influence of the controlled-cycle mechanism, the wheels then close to grind the piece and open again, after which the piston of cylinder B moves back the slide and turret, the latter being indexed through 45° during this withdrawal by means of a Geneva mechanism, thus bringing the next piece into line with the grinding throat.

The usual stock removal for this class of work is 0·003 in. and machines normally operate on an 8-sec cycle, producing work to the exacting limits set by drill-bush makers.

Spot Welding to Cut Pilfering Losses

A large Birmingham manufacturer reported large-scale pilfering of goods from packing cases shipped to African markets. The wooden packing cases, bound with metal strips and nailed, were being opened without any apparent sign and their contents pilfered. Welding technicians at British Oxygen Gases were called in and advised Argon spot welds to join the flat-headed nails to the binding metal strip. This makes it impossible to remove the nails or binding without signs of obvious interference.

Oil Prospecting in Remote Regions

The search for oil has called for some unusual mechanical equipment lately. In the present article some idea is given of the difficult conditions in which it is used

THE geology of the inhabited parts of the earth has been studied thoroughly and the oil fields in these places all seem to be known. New finds have been in remoter districts and oil prospecting is now penetrating into jungles, deserts and the sea bed. As notes in our pages have indicated from time to time these expeditions require special equipment, which is often elaborate and costly, and when oil is found a town may have to be built and a pipeline laid to convey the oil to port or refinery.

A lot of exploratory drilling goes unrewarded. For instance, of the 11,383 drillings made in the U.S.A. in 1957, 90% proved to be dry. The work is costly too: in the ten years up to 1956 the industry spent nearly £1000 million on the acquisition of ground and in drilling.

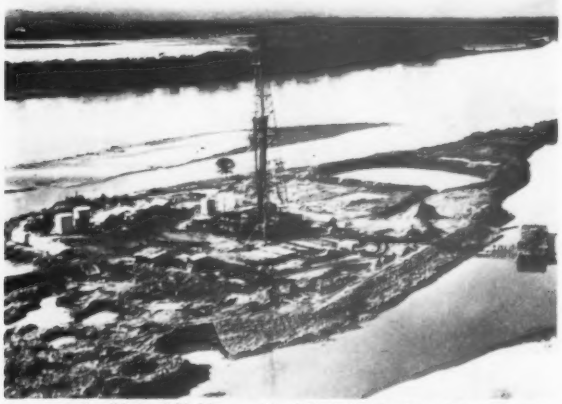
Swamplands

The first locally produced crude oil was shipped from Nigeria to Europe last year. This represented the first concrete reward for a monumental job of exploration that, begun in 1937, has so far cost over £40 million. The search area extended over 38,000 square miles of Nigeria, including deep bush and the mud and swamps of the Niger Delta. Exploration parties, engaged in geophysical and test drilling operations, depended to a large extent on helicopters for essential supplies and high powered radio sets for communication.

Seismic drillers plough through thick mud with heavy equipment during 'shooting' operations in the mangrove swamps near Calabar, in the Eastern Region of Nigeria. Launches and canoes are essential items of transport in this exploration area

In early 1956 the Shell-BP Petroleum Development Company of Nigeria encountered a promising show of oil, at Oloibiri, 45 miles west of Port Harcourt, a location deep in the Niger Delta region of tangled mangrove swamps, some 9000 square miles in extent. This meant, when test production began, that a 70-mile-long pipeline had to be constructed through the swamps to Port Harcourt, from where the oil could be shipped. Today Oloibiri is Nigeria's first oilfield, producing 3000 barrels a day, and oil is also being pumped to Port Harcourt from Afam, 20 miles east of the port.

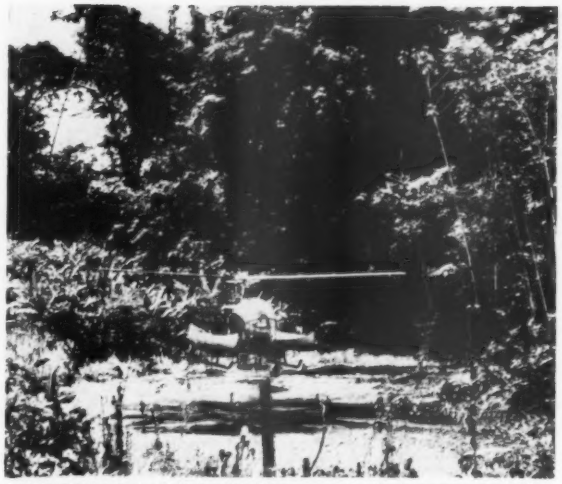
Both these fields, however, appear to be small and complicated and further production experience must be awaited before the economic aspects of these fields can be evaluated satisfactorily.



An appraisal well being drilled from an island site in the Magdalena River, Colombia. The 'Dutch Mat' protection against erosion can be clearly seen

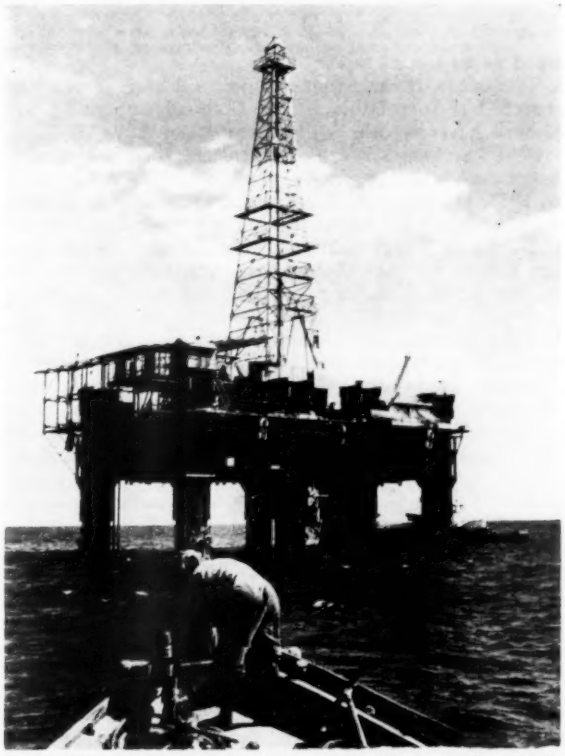
Jungle and water

In the middle Magdalena valley in Colombia seismic parties of Shell Condor S.A. are working in a region of dense tropical forest, swamps, lakes and rivers. In such terrain helicopters are worth many times their weight in mules, trucks and boats for they afford access to areas which cannot be reached by other means. They fly between 165 and 370 hr a month, carrying survey men, fresh food, dynamite, drill-hole casing and petrol to jungle camps. Sick workers can be flown out quickly and replacements flown in. The ground party chief travels by helicopter to control and supervise work. A few minutes flying enables him to visit several groups engaged on cutting trails, drilling or seismic shooting.



A Bell 47-D helicopter bringing aluminium canoes to seismic survey personnel in a swampy jungle clearing of the Middle Magdalena Valley, Colombia

A dog team rests in the snow whilst gravity readings are taken during winter oil search operations in Alberta, Canada



The massive bulk of the steel island at the first location off Qatar in the Persian Gulf. Subsequently, despite the staunch construction, it was wrecked by a storm when preparing to move to another location

As water often provides the only landing space, the helicopters operate on floats for much of the time. They can carry light aluminium canoes if required.

The Condor field force found the Magdalena River a formidable obstacle. In order to continue the development of the Yarigui oilfield, through which the Magdalena flows, it was necessary to build a drilling location, Yarigui 3, on one of the islands in the river. This was a risky undertaking because of the strong water current and the unpredictable nature of the Magdalena, which when in flood can sweep whole islands and sand-bars downstream. Hardly had drilling begun when a change in current caused rapid erosion of the river bank. A barrier of old oilfield pipes was raised against the swirling waters, and later a protective rock groyne, but something more permanent was needed. The old Netherlands "Dutch Mat" system of protecting river banks and dykes was employed. A raft 50 ft by 80 ft and about 2 ft thick was made of brushwood, covered with a rock layer, and sunk into position. The projecting level was then topped by a smooth surface of gravel sand. Wooden fences pegged firmly into the underlying raft prevented the stones from slipping.

Arctic regions

In the short northern summer of 1958, Shell Oil Company of Canada mapping parties recorded between 60/70,000 square miles of territory, stretching north from the oil-rich province of Alberta. Six field parties were sent from the base camp, East 3, 120 miles north of the Arctic circle, to explore three areas: the Franklin Mountains area lying west midway between Great Slave Lake and Great Bear Lake; an area east of the Mackenzie River delta; and in the Richardson Mountains, in the north-westermost corner of Canada.

Each party consisted of a geologist, an engineer, a student geologist and a cook. In addition a helicopter pilot was attached to each party for, in this rugged territory, air travel enables geologists to cover several times as much territory as by horse, canoe or motorboat. Help was also given by a Dakota primarily employed in flying provisions from Edmonton (Alberta) to the East 3 base camp, and two Otter aircraft which supplied the party camps. Radio communications were set up between base, the camps, and the Shell aircraft and helicopters. A portable laboratory, installed at East 3 base camp, sent back technical reports on samples and information collected in the field.

With the autumn and the onset of the winter freeze-up came the seismic and test drilling crews with tracked vehicles to probe the likely areas. Only in winter are the peat-bog 'muskeg' areas firm enough to take heavy equipment. Under the muskeg there may be oil. If working conditions are exceptionally hard it merely means that the oil will take that much longer to find.

Offshore search

When the seas and oceans have to be explored the problems grow in size and complexity. Costs are trebled and weather hazards can bring disaster. In 1953 The Shell Company of Qatar Limited (then the Shell Overseas Exploration Company) began operations in a 10,000 square-mile marine concession on the Persian Gulf. First came eighteen months of gravimetric and seismic surveys to determine where to drill with the best chance of success. These operations involved the use of a 4000-ton depot ship, a small fleet of launches, and short-wave shore stations for sending out the signals required for the navigating system which determined the exact position of the survey launches.

The second stage, exploratory drilling, began in late 1954 with the erection of a 1200-ton movable steel island at a cost of £900,000. The platform was used at two locations, both of which proved unsuccessful. Disaster came as the platform was about to be towed to shore for modification. A violent storm developed, wrecking the platform and halting drilling after an outlay of £7 million without finding oil.

Sand dunes

The sands of the Sahara contain oil and six years of search in the desolate Southern Territories of the French Sahara have already tapped rich oil and gas deposits. By 1960 or 1961 it is estimated that total output may be some 8 million tons yearly, rising to 25/30 million tons by 1965. The initial discovery was made by the Compagnie de Recherches et d'Exploitation de Petrole au Sahara (35% Royal Dutch/Shell) with the Edjele field, close to the Libyan frontier. This success was followed by two further fields; and the producible reserves of the three have been tentatively estimated at some 100 million tons. C.R.E.P.S. has also located reserves of gas. Striking successes elsewhere have been made by other French interests, notably the vast Hassi R'Mel gas field and the Hassi Messaoud oil-field and oil is already reaching France from Hassi Messaoud. Many oil companies and associations of companies are taking part in the search, including Compagnie des Petroles d'Algerie (65 Royal Dutch/Shell) which has exploration permits covering some 30,000 square miles.

Despite all amenities, Sahara geophysical survey and test drilling crews lead a spartan life. Distances covered are vast, air and radio communication essential, and new roads and tracks have to be made to take the heavy wheeled vehicles needed for the job. Water points are far apart, and extremes of climate and squally, desert winds have to be endured. Drilling is carried out all the year round, even during the full summer heat of 120° F in the shade.

Up to September of last year 33 exploration wells and a number of coreholes had been drilled by CPA crews and total expenditure had grown to about £17 million. So far no oil has been struck but the seismic explosions continue and new test wells are still being sunk.

Construction of a mess hall at a drilling site south of Timimoun in the French Sahara, some 500 miles inland from Algiers. The camp for the civil engineering party is seen on the horizon. The job of the engineers is to prepare new drilling sites, i.e., rig and machinery foundations, construct semi-permanent mess buildings and clear and level tracks to the site as required

Gauge Testing up to 8000 psi

Pressure gauge testing to an accuracy with 0·03% is guaranteed with the Budenberg Ranger, a dead weight pressure gauge tester for pressure readings between 10 and 8000 psi. The degree of accuracy is determined by a comparison test under pressure, between the high and low pressure piston/cylinder assemblies of the piston unit supplied and a piston/cylinder assembly specially calibrated by the N.P.L.

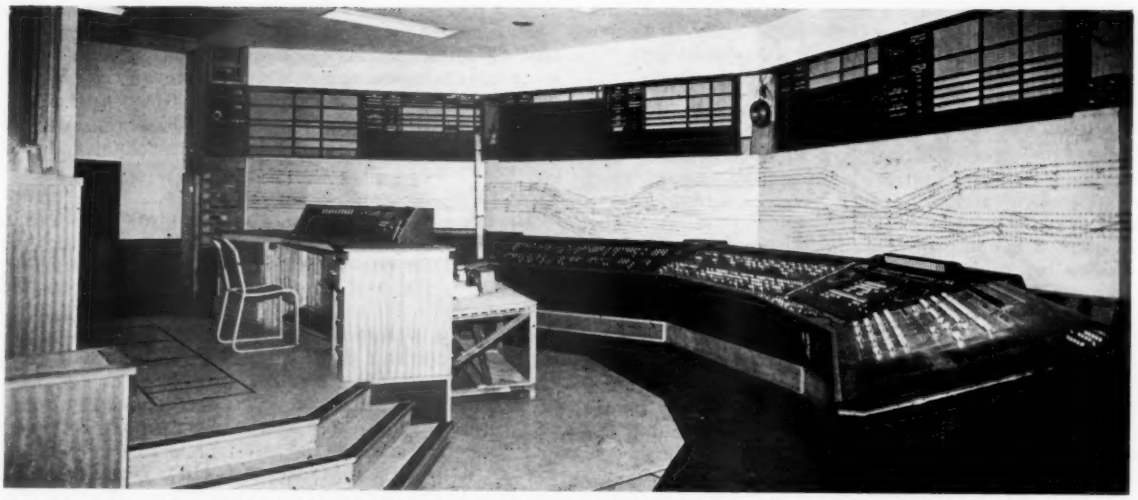
A patented priming pump combined with the oil reservoir, quickly fills the system and applies an initial pressure up to 150 psi. Pressure can be rapidly increased by a few turns of the main screwpress, which is fitted with a ball thrust and ground screw thread. Operation is simplified by the provision of a patented dual piston unit, with piston sizes of $\frac{1}{8}$ and $\frac{1}{80}$ sq in. for low and high pressure ranges respectively. The changeover from one range to the other is made automatically as pressure is increased or decreased by the screw press. A ratio of 10:1 can be obtained without changing the weights, thus enabling a pressure gauge to be checked at both ends of the scale with a minimum of effort.

Adaptors for all common types of standard and flush-mounting gauges, can be supplied by the makers, Budenberg Gauge Company Limited, Broadheath, Manchester.

Wider Use of Polyurethane Rubber

Since they first introduced Prescollan polyurethane rubber in 1955, Precision Rubbers Limited of Bagworth, Leicester, have carried out extensive research and development, and in the early stages processing limitations existed which restricted the practical shapes to those obtainable by pouring the liquid preparation into open moulds, prior to subsequent treatment. The improved technique of processing has made Prescollan suitable for a very much wider range of applications. Typical examples of components now being made are: seals, bearing pads for greaseless ball joints, bearing bushes for car steering columns, bellows, small belts, guide bushes, driving couplings, beadings, etc.

Precision Rubbers Limited have concentrated upon research into new techniques which have resulted in the production of specialised grades of Prescollan for engineering applications; this has been extremely successful as is evidenced by the increasing utilization of Prescollan by U.K. industry. Engineers and designers have recognised the unique characteristics of this material, particularly its high mechanical strength and extreme resistance to abrasion; they have also been attracted by the facility with which Prescollan can be machined into components from bar stock.



The interior of the control room nearing completion. On the left is the soundproof glass panelled room for the use of the station announcer. Left centre is the traffic regulator's dais. Centre and right is the switch console with the track diagram panel above and behind. The train describer panels can be seen above the track diagram

Graphic Railway Signalling

The new power signalling installation, incorporating colour light signals and route relay interlocking, at Newcastle Central station has 641 *route switches and is housed in a new air conditioned signal box. It takes over the work previously done in four separate signal boxes in which there were a total of* 538 *levers and* 34 *switches. It controls* 10 *miles of track and there is provision for future extension*

IN the area controlled by the installation there are 94 colour light signals of the 'searchlight' type and 61 of these have 'theatre-type' route indicators. For shunting movements, there are 170 subsidiary signals, 84 of which embody 'calling-on' indicators and work in association with the colour light signals. On the portion of track controlled by the new installation there are 131 sets of points, including 13 switch diamond crossings and one of the most complicated rail intersections in existence.

The whole of the 10 miles of track controlled, is divided up into 260 'track circuits', and trains occupying any of these track circuits automatically control the relevant signals and points.

Control room

The control room houses a switch console behind and above which is a panel carrying a diagrammatic plan of the track controlled. These are arranged in four sections with one signalman operating each section. Between the outer and inner switch consoles are short sections of console on which are mounted the train describer control pushes and the signalmen's telephone switches.

The individual track circuits are depicted on the panel diagram by distinctive colours and when any track circuit is occupied by a vehicle or vehicles a red light at each end of the track circuit is illuminated. Once a route is cleared for the passage of a train a series of small white lights appear on the diagram so that a succession of lights appears over the length of track for which the route has been cleared. These white lights remain illuminated until the movement has been completed and the route restored to normal. Altogether there are 2840 route lights mounted in the panel diagram.

The panel diagram also displays a number of green lights linked with push button controls situated on the station platforms. When a train at any particular platform is ready to start this is indicated to the signalman by the official in charge operating the appropriate press button, which in turn causes the appropriate green light to flash. This light is extinguished when the platform starting signal is cleared.

The clearing of a route for the passage of a train is accomplished by turning the route switch for the particular route involved. These route switches are of the plug in type and are situated on the sloping portion of the console. They are arranged in two groups. The lower group contains all switches relating to signals with even numbers which control routes reading from right to left of the diagram. The upper group contains the switches relating to signals with odd numbers which control routes reading from left to right. The route switch knobs are coloured red for the main colour light signals and white for the subsidiary signals.

On each of these groups of switches there are three small indicating lights (one red, one green and one white) for each signal concerned. The red light indicates when the signal is at danger. The green light indicates when the main colour light signal is clear and the white

indicates a clear subsidiary signal. With each signal there are route switches controlling each of the various possible routes. Each route switch is engraved with the identifying number of the route to which it applies and mounted above the switch is a small engraved plate describing the route it controls.

Provison is made for operating points individually and independently from normal route setting arrangements by separate point switches each having a normal, reverse and central position. These switches are normally maintained in the central position and must be in this position before the points can be operated by the route switches. The position of the points is indicated to the signalman by lights. For each pair of points there are three small white lights; one indicates when the points are in the normal position, one indicates the reverse position, and the third (placed centrally between the other two) indicates by a flashing light when the points are not operating correctly. When this occurs, the signalman can move the points by means of the switch and this movement will usually restore correct operation. Each individual point switch is equipped with an engraved plate giving the identifying numbers of all the other pairs of associated points which have to be suitably positioned in order to release the points concerned.

There is a glass panelled soundproof room for the station announcer using the public address system and a central dais for the Traffic Regulator from which he has clear vision of the panel, the switch console, and the train describer display indicators.

Operating procedure

The main signal controlling the entry of any train into a particular section of line can only be cleared after the various intervening subsidiary signals up to the next main signal have been proved to be clear, and the operation of the appropriate route switch clears the signals and sets the points for the route required to be covered. The turning of the route switch first energizes the main signal lock relay reverse which in turn energizes the associated subsidiary lock relays reverse (where provided). The intervening subsidiary signal lock relays then reverse in sequence up to the next main signal. All the signals are now ready to be cleared. The last subsidiary control relay then proves the track clear and the points correctly set before the signal goes to the clear aspect. The intervening subsidiary control relays then operate similarly in sequence back to the main signal controlling entry to the section, the signals going to the clear aspect. This now gives the condition of all intervening control relays energized and a full track circuit control throughout the whole route and all signals showing the clear aspect. It is possible in an emergency for the signalman to put any of the intervening subsidiary signals to danger after the train has entered the section.

It is frequently required to bring a train into an already occupied section, e.g. to a platform, part of which is already occupied by a train. This working is made possible by separate use of the subsidiary signals, each one of which has a separate controlling switch in the signal box. The main signal is of course maintained at danger but the subsidiary signal at the point of entry gives a 'C' (i.e. 'Calling-on') indication to the driver of the train and the intervening subsidiary signals are cleared individually up to the point required.

The installation embodies 'approach-locking', a safeguard to prevent the route being restored and a conflicting route cleared in the path of an on-coming train. The presence of a train on the track circuit approaching any signal automatically prevents the "normal" lock relay from being energized. This prevents any restoration of route until the train has either moved on to the next track circuit or the approach locking has been released by the automatic time delay releasing mechanism.

Relay room and power supply

The relay room is adjacent to the control room and it has two floors and accommodates all the interlocking relays together with track, point indication and signal control relays as well as many 'stick' and other types of relay.

Electricity is obtained from two independent public supplies at 660 volt single phase. The reliability of both supplies is such that a standby alternator has not been provided. The incoming supplies are connected to the 660 volt bus bars through oil filled circuit breakers. Ring main supplies to the external signalling functions are connected to these bus bars through air-break circuit breakers as are the 660/110 volt transformers feeding the signal box 110 volt bus bars. From the 110 volt bus bars, supplies are taken to the d.c. supply rectifiers, indication transformers and the 110 volt distribution system in the relay room. The supply transformer for the subsidiary signals has both 110 volt and 55 volt secondary outputs for day and night supplies. The 'tapping' in use is remotely selected from the Control Room.

Signals and route indicators

The main signals are of the 'searchlight' type, some of four and some of three aspects. The three aspect signals, which show red, yellow or green, are confined entirely to those leading out of bay platforms. The lamp used in these signals is 12 volt, 12/16 watt, 2 pin S.B.C. tripole. The 12 watt is the main filament and the 16 watt the auxiliary filament, which is automatically brought into use in the event of the failure of the main filament. The second yellow aspects used with four aspect signals are fitted with 12 volt, 9/16 watt, 3 pin B.C. bipole lamps.

The 'two-position-light' type subsidiary signals display a white and red light in the horizontal position for 'stop' and the 'proceed' aspect is indicated by two white lights inclined at 45°. Two different lamps are used in the signals, 110 volt, 25 watt, 2 pin B.C. being used for the white lights and 110 volt, 40 watt, 2 pin B.C. for the red. This increase in wattage for the red lamp is to overcome the loss of illumination through the red lens.

The subsidiary signals associated with the main signals are different from the ones just described inasmuch as they have a 'C' ('Calling-on') sign in place of the red light. Normally no light is displayed by these signals. The 'proceed' aspect is indicated by two white lights inclined at 45°. The 'Calling-on' indication is given by two white lights at 45° as well as the illuminated 'C' sign. These lamps also are of the 110 volt 25 watt, 2 pin, B.C. type.

Because of the speed restrictions in the area controlled, the route indicators used are of the 'theatre-type'. They display the same indication at the front and back, the only difference being that the front indication is yellow and the back indication is lunar white. The rear indication is largely for the benefit of any staff working on the track. These indicators have 49 lamps, front and rear, and are capable of displaying up to 19 different indications. The lamps used are 110 volt, 15 watt, 2 pin B.C.

Track circuits

In the controlled area there are approximately 260 'track circuits', primarily to control the signalling, which are of the a.c. reactance feed type, the feed set consisting of a 150 V.A. 110/12 volt transformer and adjustable reactance. The track relays are of the double element resonated vane type with 110 volt supply for the local coil and a 1·2/2 volt supply for the control coil.

Points operation

The operation of all points is carried out by compressed air which is supplied via 2 in. dia air main from two compressor stations. The main is divided into two zones, one being fed from a compressor station situated at the East end of the signalling area and the other zone from a station at the West end.

The electro-pneumatic point layout comprises economic point movement driven by a pneumatic point cylinder motor, 5 in. dia by 8 in. stroke controlled by a 24 volt cut-off valve, style CP (Constant Pressure) which cuts off the air supply to the cylinder as soon as a full operation is complete. Continuous electrical detection of the position of each switch blade, the facing point lock and cut-off valve is provided. The correct indication is proved in all signals relating to the points in addition to the visible indication provided in the control room.

Train description

The train describer installation in the new box is linked with the adjacent boxes, and the display indicators are mounted above the panel diagram in the control room, so arranged that information giving the class and destination of each train is illuminated in a panel giving an indication of the actual signal to which the particular train is approaching. The code giving the description and destination of the train is set up by the signalman from whose section the train is proceeding, and once this is done the apparatus works automatically, being controlled by the signals and the passage of the train over certain track circuits.

Initially, the display at both the transmitting and receiving ends is shown as a flashing indication with a buzzer sounding at the receiving station. The buzzer is silenced and both displays are steadied by the depression of an 'acknowledge' key by the signalman at the box towards which the train is proceeding. Provision is made for the manual operation of this train describer apparatus in the event of any portion of the controlling signalling apparatus being out of order.

Telecommunications

Telephonic communications of various types are required on any modern signalling installation to enable the signalmen to keep in contact with the staff on the ground; in adjacent signal boxes; with engine crews at signals, and with the local traffic controllers. These facilities are necessary for the rapid dissemination of information vital to the smooth working of a heavy concentration of both passenger and freight traffic. Therefore, a considerable number of telephone circuits converge into the signal box. Access to the circuits can be made by the signalmen at various keyboards which are built into the signal and point switching console. The traffic regulator on the dais behind the signalmen can by means of a large telephone keyboard communicate with station and sidings staff at numerous points and with other traffic controls. A total of 47 direct telephone circuits link the signalmen with specific signals throughout the signalling area which enable engine crews to converse with the signalmen.

Planning

The preparatory and initial work in preparing the scheme was started by the late Mr. C. Carslake when Signal and Telegraph Engineer of the North Eastern Area of the L.N.E.R. It was continued by Mr. J. H. Fraser, O.B.E. when Signal and Telecommunications Engineer of the North Eastern Region of British Railways, and it has been completed and brought to fruition under the direction of Mr. A. F. Wigram, A.M.I.E.E., Signal Engineer, North Eastern Region, British Railways. The internal work (wiring, erecting relay racks, etc.) has all been carried out by Westinghouse Brake and Signal Company Limited, with the exception of the telephone and train description apparatus which has been installed by The Standard Telephones and Cables Limited. The outside work relating to signals, points, track circuits, cabling and cable housings (steel) was carried out by the Signal Engineer's staff who also provided the temporary circuits in the existing signal boxes to control the new signalling prior to the opening date. The principal contractors for the construction of the buildings were, for steelwork, E. Davis (Fixers) Limited, York, and for general building work, Hadden & Hillman Limited, Newcastle. The civil engineering and construction work was designed and carried out under the direction of Mr. A. Dean, M.I.C.E., Chief Civil Engineer, North Eastern Region, British Railways.

Mobile Cranes for Rough Site Work

Increased travelling speeds and a greater tractive effort are features of the Coles models S510, S1110, S1210 and S1510, self-propelled, diesel-electric cranes which have been developed for working on rough or muddy terrain, such as is often experienced on building and other undeveloped sites. The improved performances are effected by the use of larger travel motors and generators, and equipping the cranes with 4 × 4 wheel drive. Now named the Mudmaster range, these additional features are available as optional extras to each of four models as follows: the standard model S510, the Diligent of 6 ton capacity with a maximum travelling speed on level ground of 3 mph will now be available with a top speed of 12 mph on level ground and the tractive effort increased to 7800 lb as against 3700 lb with the standard machine. The Matchless Model S1110 of 10 ton capacity and with a normal travelling speed of 4 mph has increased speeds of up to 10 mph. The standard machine has a maximum tractive effort of 6700 lb but with the 4 × 4 wheel drive this is boosted to 29,000 lb and with the 4 × 2 high speed modification the tractive effort becomes 10,000 lb.

The maximum travelling speed of 10 mph the Dominant Model S1510 remains unchanged. However, it is possible to equip the crane with a 4 × 4 wheel drive which will increase the maximum tractive effort from 10,000 lb to 29,000 lb and enable it to negotiate a 1 in 2 gradient.

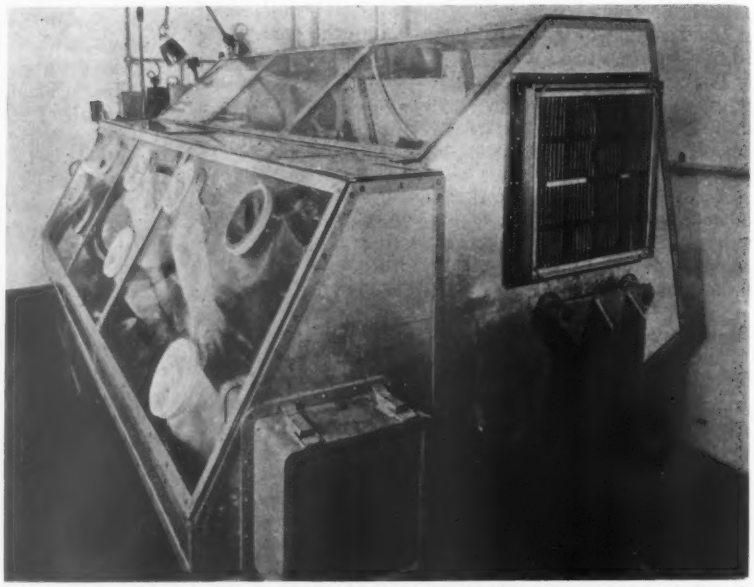
The speed of the Aenaes Model S1210 of 10 ton capacity model has been increased to 10 mph. Installation of a 4 × 4 wheel drive provides maximum tractive effort of 29,000 lb and the four wheel drive makes it possible to negotiate gradients of 1 in 2. Coles Cranes are manufactured by Steels Engineering Products Limited, Crown Works, Sunderland.

Components for Nuclear Reactors

Some results of ten years of research, design, development and construction in the Fairey organization.

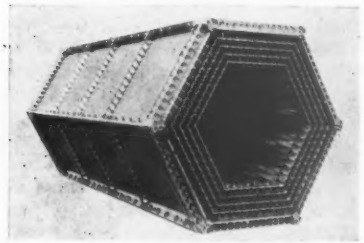
IN 1957 the Fairey Group of Companies joined Atomic Power Constructions Limited, one of the five groups set up for the design, development and erection of nuclear power stations. Since that time no details of its work have been published apart from references by the United Kingdom Atomic Energy Authority to the fact that Fairey Aviation has made a great quantity of fuel element containers and numbers of large steel and aluminium fabrications for reactors and other nuclear installations.

The Fairey Company has two main groups of factories in the United Kingdom. The heavier engineering production is concentrated in Fairey Engineering Limited at the Stockport (Heaton Chapel) factory. It has specialized in the manufacture of welded fabricated aluminium pressure vessels, particularly for the Capenhurst diffusion plants. Welds in five to six inch thicknesses of aluminium, to Class 1 standards, are now commonplace and the current output of such pressure vessels is of the order of 100 tons per month. Fabrication in stainless and non-stainless steel is also undertaken; work has been done, for instance, on the burst cartridge scanner gear pipework and irradiated fuel disposal pond handling equipment for Windscale, and on the stainless steel core, gagging skirt and breeder blanket of the Dounreay fast reactor and on various components for the Materials Testing Reactor.

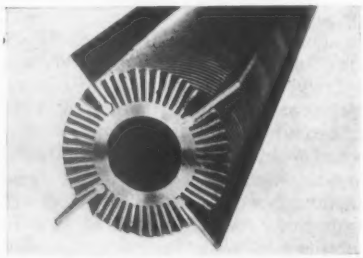


A machine specially adapted by Fairey Aviation Limited at Hayes, Middlesex, for machining of beryllium. It gives the operator full protection from the toxic effects of this poisonous metal.

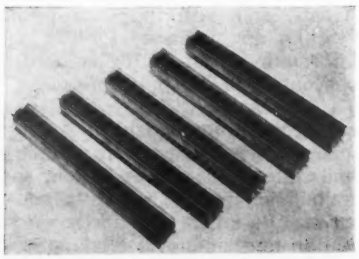
The Stockport factory has also been responsible for the design, development and manufacture of special purpose machine tools. These include the automatically-controlled and remotely-controlled machine tools and devices which are so necessary for handling and machining highly radioactive components behind adequate shielding. It has developed, for example, a machine for automatically machining anti-ratchetting grooves on uranium fuel element rods. At the other end of the scale is the Fairey-Ferranti computor-controlled three-dimensional milling machine. Current plans for expansion at Stockport include the setting up of a graphite machining facility capable of handling the supply of graphite moderator blocks for power reactors. Some work is already being done on a small scale to provide machined graphite components for other nuclear work.



Gagging skirt for the Dounreay fast reactor manufactured completely in stainless steel 18/8/1 and weighing 30 cwt



An experimental helical finned can for an atomic fuel element. It is made of magnesium and fitted with splitters attached by a Fairey Aviation patented method



Helical finned cans for atomic fuel elements made of aluminium alloy by Fairey Aviation Limited for the United Kingdom Atomic Energy Authority

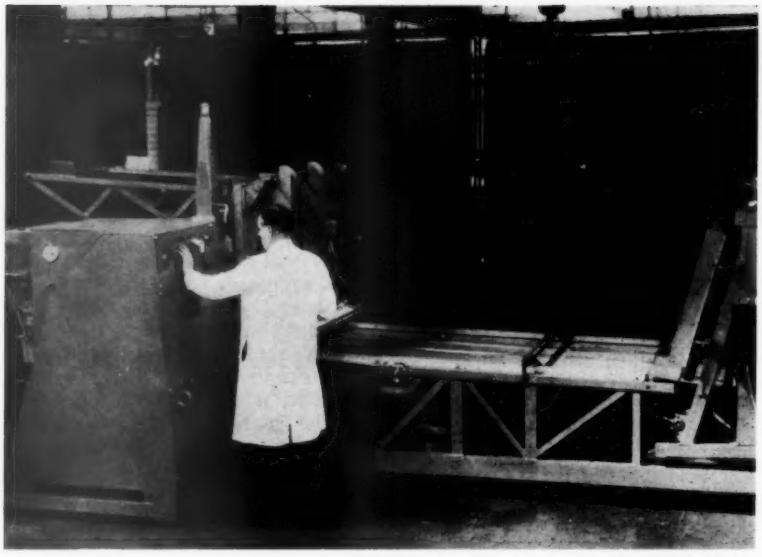
The Hayes factory has been engaged in manufacturing fuel element cans in aluminium and Magnox in large quantities. The designs range from the longitudinally finned cans of early aircooled reactors, through those of the Pippa type employing transverse finning, to the more modern cans having multi-start helical fins and external flow-splitters—the so-called polyzonal spiral fuel element can. A great number of other designs have been manufactured in smaller quantities for heat transfer research work by the Atomic Energy Research Establishment and by the various consortia.

Whilst in the early stages it is often necessary to fabricate specimens of these cans of new design by "knife-and-fork" methods, as soon as the design begins to show promise, production development engineers face up to the problems of manufacturing the can cheaply and accurately in large quantities. Thus a process has been developed for manufacturing integrally finned tubes of the Pippa type for the commercial market. Trade-named "Fairfin" tube, it is made in a variety of sizes and materials and is being widely considered for use in many industries. A developed composite version in which external aluminium fins are metallurgically bonded to an internal steel tube is exciting considerable interest. A further possibility available is an integral tube having internal longitudinal finning and external transverse finning.

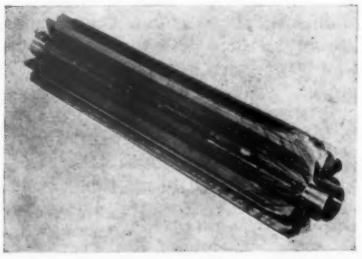
Another specialized production technique, of interest to the nuclear engineering industry, which has been developed at the Hayes factory, is investment casting in high tensile steel. Complicated components, up to 60 lb in weight, can be precision cast and a number of reactor components are being manufactured in this way. A prototype beryllium machining and handling facility has also been set up there.

The Hydraulics Division of the company, also located at Hayes, has specialized for many years in the production of high performance hydraulic system components. Special emphasis is given to mechanically and electrically signalled position servo valves, certain dimensions of which are controlled to within $\pm$ 5 micro-inches.

The adequate protection of such precise mechanisms necessitated the development of high grade micro-filters with guaranteed particle cut-off size. The success of these hydraulic filters highlighted the general need for high grade positive filtration, and low pressure loss filters have now been developed for closed-circuit and circuit-to-atmosphere filtration of reactor plant gas system, the cut-off sizes being $2\frac{1}{2}$, 5 and 10 microns respectively.



A bar-grooving machine designed and developed by Fairey Engineering Limited at Stockport, in conjunction with, and to the requirements of, the U.K.A.E.A. It machines anti-ratchetting grooves in the uranium slugs before they are inserted in the finned cans



Longitudinal finned can for an atomic fuel element made in aluminium alloy by Fairey Aviation to a U.K.A.E.A. contract for Windscale

A rolled finned can in magnesium alloy with the specially designed end for U.K.A.E.A. requirements magnified for clarity. So far as is known this type of end can be produced only by Fairey Aviation's finning process

Carbon dioxide pneumatic actuators have also been developed for reactor plant applications.

A joint Hayes—Stockport project has been the design, development and manufacture of a prototype axial flow compressor for Capenhurst. This compressor is currently being tested.

U.S. Nuclear Power Unit for Italy

The nuclear steam generating plant which is to be supplied by the Westinghouse Electric International Company to the Società Elettronucleare Italiana (SELNI) of Milan for the latter's Enrico Fermi power station is scheduled to begin operation in spring of 1963 and to have a net capacity of about 160,000 kW. The reactor will be of the pressurized water type similar to that being built for the Yankee Atomic Electric Company. The station will normally operate as a base load plant, providing a regular supply of electrical energy to the power network of the Edison Group, the largest privately owned utility in Italy, and other utilities in Northern Italy.

Modern Engineering Workshop Practice. Editorial consultant: W. A. Tuplin. London, 1959; Odhams Press Limited. Four volumes, £9 5s. 0d. net (by post £9 8s. 3d.). 1150 pp. +44 data sheets. 7×9½ in.

Biological specialization is a dead end, and that may prove to be true of industrial specialization. The specialist must know a great deal about his own subject, but to use his knowledge to the full he must understand the fundamentals of all related subjects. The engineer is no exception and his reading must be general as well as particular. Anyone concerned in any way with workshop practice must often have felt the need of reliable fundamental information outside his own speciality, and has often found that the literature does not help, it being either superficial or too specialized. Dr. Tuplin's team have gone a long way towards putting this right. They have provided expert illustrated surveys of some 30 aspects of their subject, each one neither exhaustive nor inadequate but definitely fundamental and useful.

There are three volumes, the first dealing with bench work, engineering drawing, mathematics, materials, inspection, the lathe and turning and screw threads. The second volume deals with welding, soldering and brazing, the use of jigs and fixtures, toolmaking, machine tools, precision finishing machines, gears and gear cutting, foundry work, stress analysis and flaw detection, and diecasting. The subjects treated in the third volume are forging, heat treatment, sheet metal work, rust proofing and surface treatment, electroplating, time and motion study, materials handling and storage, power supply for machinery, machine installation, factory regulation and safety devices, and patents, designs and trade marks. The fourth volume is a book binding fitted with two pockets made to receive 44 once-folded data sheets relating to materials, cutting tools and welding as well as general tabular matter.

The practical value of the work, for reference, lies in the scope and the particular treatment. It is not a book from which to learn how to do a job but to appreciate how it is done and enable one to deal on fair terms with one's opposite number in another branch. For study it offers the student a solid basis for viewing a wide field and will enable him the better to progress in his own chosen line.

Industrial Accident Prevention. By H. W. Heinrich and E. R. Granniss. New York, 1959; McGraw-Hill Book Company Inc. London; McGraw-Hill Publishing Company Limited. 70/- net (by post 71/9). 480 pp. 6 × 9 in.

In many places safety precautions just accumulate as a result of trying to prevent the recurrence of persistent or particularly distressing accidents. They make a heterogeneous collection and depend very much for what success they achieve upon the emphasis with which they are passed on. This is the old way, and it is very different to the new. There is ample evidence now of the positive results to be gained by tackling safety scientifically; and it can be done

books

anywhere—not just in the big factories where it has had most success, but in work places of any size, down to the smallest. This is because it arises out of the conscious practice of certain principles by everyone, and not just by the people who most often get hurt. There is a basic philosophy to the subject, of which the authors of this book (now in its fourth edition) are noted exponents, and with the understanding that this brings the comparatively few principles become very real, and faults of environment and omissions of practice become very plain—as plain as what is needed to remove them. Of course, accidents should be avoided. To have to prevent a recurrence is usually an indication of failure. The authors' methods are very helpful in building safety into a plant from its inception. They have a great fund of experience on which they draw for illustration and altogether they have provided a complete working text on their subject.

Descriptive Geometry. By E. G. Paré, R. O. Loving and I. L. Hill. New York, 1959; The Macmillan Company. 35/- net (by post in U.K. 36/3). 349 pp. 6 × 9¼ in.

The difference between descriptive geometry as treated in this book and the teaching of engineering drawing in many books is not in the subject matter but in how it is regarded. Thus the book opens familiarly with orthographic projection and primary auxiliary views but there is an element of scientific rigour in the laying down of principles and in the choice and treatment of examples. The problems encountered in practical drawing are treated in this way throughout—planes, piercing points, intersections, angles between planes, parallelism, perpendicularity, concurrent vectors, plane tangencies, intersections of planes with solids, developments, shades and shadows. The examples concern real objects (real in the engineering sense) and are frequently physical realities like screw conveyors, ships' hulls, force diagrams, driving gear and topographical formations. The book is primarily intended for use in class and laboratory, but by reason of its closeness to practice it will appeal readily to the practical draughtsman than many of the academic treatises of similar title.

First Steps in Heat Transfer. By James Small, London, 1959; Blackie & Son Limited. 12/6 net (by post 13/1). 86 pp. 5¾ × 8½ in.

Professor Small has a solid purpose in writing this book: it is to provide an exposition of some of the easier parts of the subject which can immediately be put to some practical use. This is much better these days than confronting the newcomer with a massive text. He keeps the mathematics to quite a low level and where calculus is necessary it is apart so that the rest of the book is in no way dependent upon it. The examples concern actual problems like steam condensers, pipes and engine cylinders and they are worked out in full. The principles are very clearly explained. Professor Small has the younger reader in mind but anyone not too familiar with heat transfer and who wants to get a ready grasp of it will find the book of real help.

B.E.A. Handbook.—The 1959 edition of the British Engineers Association classified handbook includes a comprehensive list of members' products classified alphabetically under more than 3,000 headings and so arranged as to be of the maximum assistance to purchasers of engineering equipment. The classified index is repeated in French, German, Portuguese and Spanish. The handbook also includes an index of Trade Names and Trade Marks. Copies are being sent free of charge to selected buyers of engineering equipment in every country in the World which has business with the British engineering industry. The handbook may be purchased from the B.E.A. price 21/-.

Economic Survey of Europe, 1958.—The annual Economic Survey of Europe in 1958 prepared by the Secretariat of the United Nations Economic Commission for Europe, contains chapters on recent economic developments in Eastern Europe and the Soviet Union, and on the Western European economy and the possibilities for renewed expansion. The statistical data and qualitative reports on developments in the eastern European and Soviet economies suggest that in 1958 the continuing rapid rise in industrial output was everywhere accompanied by—and to a large extent due to—an elimination of the imbalances which had been the persistent accompaniment of past industrial growth within the area. More serious than the difficulties springing from short term sources were those arising from the general rapid expansion, up to the mid-fifties, of processing capacities—and particularly of the engineering industries—and the lagging behind of supplies of raw materials and fuels and neglect of agriculture. About 1955, however, the drive for new investments, and particularly for the expansion of heavy industrial capacity, was relaxed nearly everywhere in eastern Europe, and the subsequent concentration of investment efforts on completing projects already under way, on relieving the major scarcities of fuels, electric power and basic materials and on otherwise widening bottle-necks, has borne fruit in the last 18 months or so. The survey is available from H.M. Stationery Office, price 18/- net.

New Stoker's Manual.—The first edition of "The Stoker's Manual" published by the National Fuel Advisory Service proved very popular and the new edition bids fair to be no less. Indeed, if only it brings the subject up-to-date it will very likely do even better. It is an essentially practical handbook for the man who wields the shovel or handles the controls, and because it goes some way towards explaining the theory as well as the practice it will appeal to the type of man who makes a good boiler operator. NIFES has done a lot towards the emergence and recognition of this type and the new edition of the manual will help this work along. Engineers who have boiler plants in their care will do well to see that their operators (and some other people) each have a copy. It is available price 2/6 net from NIFES, 71 Grosvenor Street, London W1.

Mining Subsidence.—Engineers responsible in any way for buildings or other structures or for buried pipes and cables in areas subject to mining subsidence will find a new report entitled "Mining Subsidence" of practical value. Published by The Institution of Civil Engineers, Great George Street, London SW1, price 10/- post free, it is the result of six years' investigation by a committee under the chairmanship of Dr. W. K. Wallace. In addition to giving advice on what to do about subsidence it indicates also procedure on the prediction of ground movement.

Soviet Technology.—Engineering Information Services, 8 Victoria Road, Kirkham, Lancashire, have commenced the publication of "Digest of Soviet Technology", the first number of which contains abstracts relating to various aspects of design and production, metallurgy, welding and foundry production, instruments, and automation. The publishers have a follow-up service for supplying full texts in English.

Russian Patents in English.—The Technical Information Company, Chancery House, Chancery Lane, London, WC2, have announced the publication of "Russian Patents Gazette" containing English language abstracts of new Russian patents and invention certificates arranged under 91 class headings.

New Standards

Nickel copper alloy castings (B.S. 3071:1959). Price 4/-.

Nickel and nickel alloys—Sheet (B.S. 3072:1959). Price 5/-.

Nickel and nickel alloys—Strip (B.S. 3073:1959). Price 5/-.

Nickel and nickel alloys—Tube (B.S. 3074:1959). Price 5/-.

Nickel and nickel alloys—Wire (B.S. 3075:1959). Price 4/-.

Nickel and nickel alloys—Rods and sections. (B.S. 3076:1959). Price 5/-.

This series of standards for nickel and nickel alloys supersedes the earlier series, B.S. 1525–1537, issued in 1949 and the standards for wrought materials have been re-grouped so that one document applies to each wrought form. Requirements for the three materials included in the earlier series of standards have been amended, and a fourth material—low carbon nickel—has been included for some forms. Sheet and strip material, previously dealt with under one cover, are now treated separately as different tolerances apply and low carbon nickel is not normally supplied in strip form.

Insulating oil for transformers and switchgear (B.S. 148:1959). Price 8/6.

This revised edition of B.S. 148 applies to unused insulating oil suitable for the immersion or filling of transformers, switchgear, and certain other electrical equipment in which oil is required as an insulant or for heat transfer. It does not apply to high viscosity oils, to oils required for cables or capacitors, or to oils for special impregnation purposes. Minor changes in the present revision, compared with the amended 1951 edition are the deletion of the evaporative loss test, and the improvement of the procedures for acidity determination by the substitution of alcoholic alkali for aqueous alkali. A new appendix has been introduced giving the characteristics of the thermometers used in the various tests.

Code of Practice for Guide to the loading of transformers to B.S. 171 (CP. 1010:1959). Price 7/6.

Guidance on the loading of oil immersed transformers to B.S. 171 (Power transformers) with Class A insulation, given in C.P. 1010 is based on their thermal characteristics and fittings. It sets out a list of basic data which include, as a basis for the recommendations, four categories of daily operating conditions associated with the permissible maximum temperature of the windings. The information is given in a series of tables and their use is illustrated by examples.

Magnesium and magnesium alloy ingots and castings for general engineering purposes (B.S. 2970: 1959). Price 8/6.

The requirements of the earlier standards B.S. 1272–1280, have been amended in the light of more recent experience in magnesium alloys and specifications for pure magnesium ingots, and for five new alloys in various conditions, have been added.

British Standards Institution, 2 Park Street, London, W1.

BUSINESS & PROFESSIONAL

Personal

INCLUDED in the appointments made by the Council of the Royal Society in original scientific research are the following: Royal Society Research Fellowships (Mr. & Mrs. John Jaffé Donation): **Dr. J. Owen, M.A., D.Phil.(Oxon.),** of the Clarendon Laboratory, Oxford to work on exchange interactions in magnetic systems. Royal Society Research Studentships (Mr. & Mrs. John Jaffé Donation), **Dr. M. L. Whelan, M.A., Ph.D.(Cantab.),** of the Crystallographic Laboratory, Cavendish Laboratory, Cambridge, to carry out investigations of metal by transmission electron microscopy. Paul Instrument Fund Committee Grant; £2000 to **Dr. H. Motz,** reader in engineering science, University of Oxford, (in association with Professor G. B. Walker, professor of electrical engineering, Essex College, Assumption University, Windsor, Ontario), for the construction of a linear accelerator working at 1·6 cm (J-band).

Mr. John G. Gershon, who, for several years, has combined the offices of sales director and Southern area sales manager of Rocol Limited, has relinquished the latter and, at the Rocol head office at Swillington, near Leeds, will be concerned with the overall United Kingdom sales policy. **Mr. E. T. Wilkinson** has been appointed Southern area sales manager for the whole of the South of England, including Birmingham and South Wales. He has been many years with Rocol and was formerly technical representative for South-East England, Hants and Dorset.

FOLLOWING the acquisition of the Willenhall lock-making firm of E. Tonks & Sons Limited by The Yale & Towne Manufacturing Company, the following changes are announced: The present sales manager, **Mr. E. A. Venner,** is responsible for domestic sales only for both Yale and the ETAS range made by Tonks. **Mr. S. E. Palmer,** previously commercial manager, becomes trade relations manager. To co-ordinate domestic and export sales, and customer relationships, Yale & Towne have appointed **Mr. R. J. Abrahams** as general sales manager.

Mr. T. R. Earnshaw, who was recently appointed a director of Ferodo Limited, has now assumed full responsibility for export sales on the retirement of **Mr. F. L. Harrap. Mr. J. D. Millner,** at present manager of the North London branch, becomes the company's manager in the Irish Republic, with headquarters in Dublin. He will be succeeded as North London manager by **Mr. W. H. Wyse,** whose place as Sheffield manager will be filled by **Mr. A. Chatterton.**

Mr. J. A. Moore has been appointed finance director of Dunlop Rubber Company (India) Limited, in place of **Mr. A. W. Gillespie,** who has retired. **Mr. L. J. Bailey,** general manager of the India Tyre & Rubber Company, has been appointed general manager of Dunlop's German subsidiary (Deutsche Dunlop Gummi Co., A.G.), in place of **Mr. E. F. Hingeley** who has retired. **Mr. D. J. Flunder** has been appointed general purchasing manager for the Dunlop Rubber Company, and will in future be in charge of the materials supply division. Since October, 1957, he has been London manager of Dunlop Plantations Limited.

PERKINS ENGINES LIMITED have divided their European export market into two separate export zones and **Mr. Edward Bartlett, B.A.(Cantab.)** has been appointed manager of a new West European zone. Mr. Bartlett joined the company in 1951 and has performed special liaison duties first in India and later in connexion with the associated French company. The East European zone is under the management of **Mr. Frank Wilkinson, M.A.(Cantab.)** who joined Perkins in 1953 and who has travelled extensively as the company's senior representative in the export department.

CROFTS ENGINEERS (HOLDINGS) LIMITED, Bradford, have announced two new directorial appointments. **Mr. J. Busfield, A.C.A.,** recently appointed secretary and chief accountant for Crofts Engineers (Holdings) Limited and Crofts (Engineers) Limited, has been appointed a director of both companies and also of J. Parkinson & Son (Shipley) Limited. Mr. Busfield joined Crofts in 1950 as asssitant secretary and chief accountant. **Mr. M. T. J. Goff,** joint managing director of Crofts (Engineers) Limited since 1951, and a director of Crofts Engineers (Holdings) Limited since 1954, has also been appointed a director of J. Parkinson & Son (Shipley) Limited.

Mr. C. W. Clarke, M.S.M.A., Fellow and Council Member of E.B.R.A., has been appointed home sales manager of the Surform division of Simmonds Aerocessories Limited, Treforest, a member of the Firth Cleveland Group. Mr. Clarke will be responsible for the marketing in the U.K. of Surform hand cutting tools and power tool attachments and will operate from the Surform division sales office at Byron House, 7–9 St. James's Street, London SW1.

THE BROCKHOUSE ORGANIZATION announces the appointment of **Mr. W. H. Solf** as its European representative. He will be responsible for co-ordinating and supervising the Group's activities in this area and will be based at the London office of Brockhouse (Trading Facilities) Limited, at 25 Hanover Square, London W1

METROPOLITAN-VICKERS ELECTRICAL Company Limited, announces that as from May 1, 1959, **Mr. L. S. Tredgett, B.Sc.(Eng.),** who joined the switchgear sales department in 1952, is appointed assistant sales manager, railway signals department.

Mr. G. S. Parish has been appointed sales manager, London area (including Home and Eastern counties) of The David Brown Corporation (Sales) Limited. Mr. Parish will be responsible for the sales of gear, foundry, machine tool and precision tool products in those areas, and will operate from the London office of the David Brown Group, 96/97 Piccadilly, London W1.

Mr. I. H. Gordon has been appointed assistant sales manager of Cambridge Instrument Company Limited, at the company's head office in London.

Mr. R. Gavin Orr, M.C., M.Inst.W., has been appointed managing director of T. C. Jones & Co. Limited, structural engineers, and succeeds **Mr. I. Levin, B.Eng., B.Sc., M.I.C.E., M.I.Mech.E., M.I.Struct.E., M.Inst.W., F.R.S.A.,** who is approaching retiring age. Mr. Levin remains a director of T. C. Jones, which company he joined in 1928.

Mr. Leslie Oloreenshaw, a member of the executive board of the Taylor Woodrow Group of building and civil engineering companies, has been appointed a member of the parent board of Taylor Woodrow Limited.

Two new appointments have been made in the meter, relay and instrument division of The English Electric Company, Stafford. **Mr. G. E. Robertson, A.M.I.E.E., Assoc. Mem.A.I.E.E.,** has been appointed manager, sales and contracts, of the meter, relay and instrument division, and **Mr. P. G. Bevis** has been appointed manager, sales and contracts, relay department.

The Earl of Halsbury, F.R.I.C., F.Inst.P., until recently managing director of the National Research Development Corporation, has been appointed to the board of Lancashire Dynamo Electronic Products Limited as chairman.

NEW FACTORY FOR MECHANICAL HANDLING CHAINS.—The entire range of Renold chains for mechanical handling are now being produced at their new factory at Burton upon Trent which was officially opened May 7. A standardized range of some 250 different base chains cover requirements from 3000 up to 85,000 lb breaking load and beyond this specialized chains up to 300,000 lb load are in regular production. The pleasing frontage of the new factory which occupies an area of 5½ acres is shown above and on the right a corner of the raw materials store looking towards the main press bay. Extensive use is made of mechanical handling conveyors to facilitate inter-process movement of components

Mr. K. H. Douglas has been appointed area office manager for the newly combined selling and service arrangements of G.K.N. (Midlands) Limited and their associate company the Scottish Stamping & Engineering Company Limited at their Coventry office (The Bridge, Broadgate House).

MAVOR & COULSON LIMITED announce the appointment to the board of directors of **Mr. Cargill S. Sandeman** as engineering director with reference to production and development.

Mr. R. E. Davis has been appointed as sales manager of Petbow Limited, Sandwich, Kent. He formerly represented BICC overseas department prior to and after the last war.

Mr. Arthur Alan Traves has been appointed project engineer with the automation division of The Hymatic Engineering Company Limited, Redditch, Worcs.

THE COUNCIL OF INDUSTRIAL DESIGN has appointed **Mr. W. H. Mayall** as industrial officer for the engineering industries. He succeeds **Mr. L. A. Grosbard,** who now has joined Mullard Limited.

NELDCO PROCESSES LIMITED announce the appointment of **Mr. John Prudden** as technical sales manager.

Mr. C. E. Wrangham has been appointed joint managing director of The Power-Gas Corporation Limited.

AMAR TOOL & GAUGE COMPANY LIMITED have appointed **Mr. T. Kershaw** as their representative for Yorkshire, Lancashire and Cheshire. Mr. Kershaw was formerly area sales representative for the Birmingham Tool & Gauge Company Limited.

Obituary

WE regret to record the death of **Mr. Geoffrey Bennett,** manager of the Liverpool factories of Automatic Telephone & Electric Company Limited.

WE regret to record the death of **Mr. Kenneth Brook, A.M.I.Mech.E.,** an executive director of C.A.V. Limited, London W3.

WE regret to record the death of **Mr. W. Rodgers,** progress officer in the steel foundry of Edgar Allen & Co. Limited. He joined the company in 1910.

Addresses

THE GENERAL ELECTRIC COMPANY LIMITED has a new sales and distribution area office at Magnet House, Hanger Lane, Ealing, W5 (telephone number: Perivale 6691). This will cover the North London, Eastern and Southern Counties area, including the existing G.E.C. branches at Ipswich, Dagenham, Luton, Reading, Southampton and Bournemouth.

RANSOME & MARLES BEARING COMPANY'S latest branch is in Southampton—42, London Road, telephone Southampton 28871—where large stocks of ball and roller bearings are held. Mr. G. D. Ball is manager.

ALL departments of Photoelectronics (M.O.M.) Limited have now moved to Oldfields Trading Estate, Oldfields Road, Sutton, Surrey. Telephone FAIrlands 4571. FIRTH CLEVELAND FINANCE LIMITED have opened a branch office in Manchester at Corn Exchange Buildings, 19, Hanging Ditch, Manchester 4 (telephone: Deansgate 5253/4), manager, Mr. E. Hibbs. Branch manager of the company's office at County House, 45, East Hill, London, SW18, is Mr. A. H. Waller.

THE telephone number of British Insulated Callender's Cables Limited, Middlesbrough branch, has been changed to Middlesbrough 3974/5.

NEWAGE MACHINE TOOLS LIMITED is the new title of the company formerly known as Lorant & Co. Limited. The address is unchanged, 98-100 Croydon Road, London, SE20.

THE London district office of Siemens Edison Swan Limited has moved into more spacious and up-to-date premises at Crown House, Aldwych, WC2. (Tel No. TEMple Bar 8040). The office continues under the management of Mr. J. A. E. Trinder; the sales service and supply element is under the management of Mr. R. J. Seaman, and the stores remain at Tyssen Street, Dalston, E8.

Film News

"*Time to Think*".—This 40 min colour film concentrates on presenting the economic case for the digital computor from the user's viewpoint. It answers the basic question "How do we find out whether a computor can be of use to us?" "Which computor will best meet our requirements?" "How do we set about preparing for its installation". Further particulars may be obtained from International Computers and Tabulators Limited, 17 Park Lane, London, W1.

"*Cutanit Cemented Carbide*".—After seeing the many processes of manufacture and production the viewer is taken on a visit to some large industrial undertakings where they can see the tools in use. Running time is 25 min and further information may be obtained from Jessop-Saville (Small Tools) Limited, Brightside Works, Sheffield, 1.

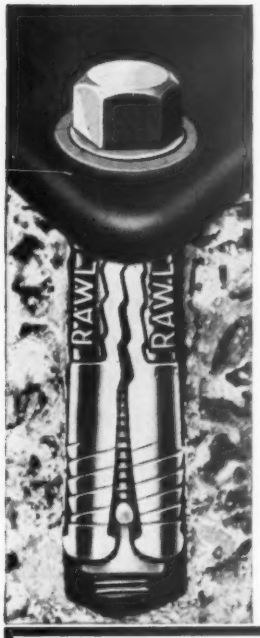
"*Lubricants with Care*" and "*Compressor Lubrication*".—These two additions in the series of industrial films made by the European group of Mobil Associates are available from industrial division offices of Mobil Oil Company. Both films were made abroad and won awards in their respective countries. Two films for future production are "Textile Machinery Lubrication" and "Gear Lubrication".

Sponsored Film Catalogue.—Issued by the G. B. Film Library, Perivale, Middlesex, this illustrated catalogue gives details of all

MAKE LIGHT WORK OF HEAVY FIXING

Every kind of bolt-fixing—in floors, walls, ceilings—completed in an hour or two and ready to take its full load! Even if there's no hurry, it's still sound business sense to get the job done efficiently and quickly with Rawlbolts. No virtue in work for work's sake!

RAWLBOLTS



PROVIDE ENORMOUS STRENGTH IN FRACTIONAL TIME

Rawlbolts are a *dry* fixing—they grip by expansion. No cold chiselling, no three-day wait for cement to harden! You *drill* the holes with one of the Rawlplug high-efficiency boring tools, hand or power. The machine is positioned, bolts tightened, and it's ready to go into operation *at once*—a rock-firm fixing that will never fail.

6 HEADS MEET EVERY NEED

For bolting to floors, use one of the 28 different sizes of LOOSE BOLT Rawlbolts (Fig. 1). These allow the machine to be slid into position without lifting. For wall fixings, use the Bolt projecting type (Fig. 2). These support the job while nuts are being tightened. For overhead and ceiling work, either type can be used. Other types are:—


1


2

Fig. 3. Pipehanger Rawlbolts (with adaptors for use with Pipehangers and other gas fittings).


3

Fig. 4. Rawlbolts fitted Pipeclips (7 sizes for ⅜″ up to 2½″ O/D pipe diameter).


4

Figs. 5 & 6. Hook Rawlbolts and Eye Rawlbolts for providing anchorage for guy ropes and cables, supporting suspended ceilings etc. (5 bolt diameters, 3/16″ up to ½″).


5


6

Write now for illustrated literature giving full details of Rawlbolts and the many high performance Rawlplug tools (hand, electric and pneumatic).

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RAWLDRILLS
for hand boring for Rawlbolt sizes A to G.

Rawlplug tools and drills are the toughest and most efficient in the world. There are sizes and types for every need—for drilling any hard material from concrete to glass, and for use by hand, electric and air power.

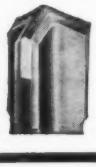
DURIUM DRILLS
—the world's fastest masonry drill. (Big range for hand and power also Long series drilling lengths 12″ and 16″.)

VIBROTO DRILLS
for vibration drilling in Vibroto machine

STARDRILLS
for hand boring all Rawlbolt sizes.

RAWLCRETE Tungsten Carbide Drills
for rotary drilling in concrete etc.

DURIUM HAMMER DRILLS



for use in electric hammers (for Rawlbolt sizes C to K).

B634

sponsored films under the 19 subject categories, over 200 films being available for free hire. The catalogue may be obtained free of charge, on application to The Industrial Department, G. B. Film Library, Aintree Road, Perivale, Middlesex.

Business Developments

Trading agreements

AN agreement providing for the manufacture of Metallux Resistors in the United Kingdom has been reached between The Plessey Company Limited and Elettronica Metal Lux s.p.a. of Milan, Italy.

AN Anglo-American company to specialize in the design, manufacture and marketing of remote-controlled nuclear handling apparatus has been set up by agreement between Savage & Parsons Limited of Watford, Herts, and General Mills Inc. (Minneapolis, Minnesota, U.S.A.). With the title Nuclear Equipment Limited, the new company will have its head office at Otterspool Way, Watford.

THE manufacture of a powerful six cylinder Perkins diesel engine for five to eight ton trucks is to be undertaken in Brazil by Motores Perkins S.A. a new company formed for the purpose as a result of an agreement between F. Perkins Limited of Peterborough and Murray Simonsen, S.A., of Brazil. An up-to-date production line for manufacturing major components at the new factory has been dismantled at F. Perkins Limited's big Eastfield plant. Totalling about 1000 tons it is probably the biggest single consignment of machine tools sent to Brazil from Britain since the war.

Company acquisitions

AMALGAMATION between J. & E. Hall Limited, manufacturers of refrigerating machinery, and Thermotank Limited, designers and manufacturers of all types of air conditioning equipment, under the title Hall-Thermotank Limited, has now been effected. The new organization is to make an offer to the shareholders of Vent-Axia Limited, fan makers and manufacturers of ventilating equipment which has been approved by the board of the latter company.

A majority shareholding in the business of Mr. John F. Tennent of 53 St. Enoch Square, Glasgow, agents for various measuring equipment manufacturers, has been acquired by Thomas Mercer Limited of Eywood Road, St. Albans, Herts.

EXPANDITE LIMITED of Chase Road, London, NW10, manufacturers of sealing compounds, jointing and weather-proofing materials, and anti-corrosive treatments, have acquired the whole of the share capital of Sealanco (St. Helens) Limited, St. Helens, Lancs., manufacturers of putties, mastics, glazing compounds and adhesives.

Agents and distributors

GEORGE COHEN SONS & COMPANY LIMITED have been appointed by John Barnsley & Sons Limited of Netherton, Worcs., as sole agents in Scotland, Ireland and South Wales for the Barnsley range of electric overhead travelling and Goliath cranes.

THE SELSON MACHINE TOOL COMPANY Limited have been appointed sole distributors of the Bruel & Kjaer surface roughness meter in the Midlands, and Eastern and Southern areas of England.

Contracts and Work in Progress

FERRANTI LIMITED.—Order for six buried type distribution transformers for South of Scotland Electricity Board.

GRESHAM TRANSFORMERS LIMITED.—Order value £20,000 from the Ministry of Works of H. M. New Zealand Government for eight 1667 KVA, 33KV, transformers single phase.

BIRWELCO LIMITED and subsidiary BROWN Fintube (Gt. Britain) Limited, Aston, Birmingham.—£300,000 order for the supply of 6 Petro-Chem Iso-Flow furnaces and tanker heaters at the Rio Duque de Caxias refinery, Brazil, for Petroleo Brasileiro, S.A.

HEENAN & FROUDE LIMITED.—To supply a 30,000 bhp hydraulic dynamometer to Burmeister & Wain, Copenhagen.

Order from G. N. Haden & Sons Limited heating engineers, London, for three P612 water coolers.

DAVID BROWN AUTOMOBILE GEARBOX Division.—£100,000 gearbox order from British commercial vehicle builders secured in face of severe competition from Germany.

E.M.I. ELECTRONICS LIMITED.—Supply of Emidec computor to J. Sainsbury Limited, grocery and provision merchants.

RECENT order for a large Emiac II computor for de Havilland Propellers Limited, Hatfield.

U.D. ENGINEERING COMPANY LIMITED.—Contract valued at £1m. from Russia for large capacity refrigeration plants. Over 25,000 hp of Crompton Parkinson motors are included in the order designed to suit the special requirements of the Russian installation. Compressor equipment is by James Howden & Company Limited.

BRITISH RAILWAYS.—Diesel fuelling equipment from The Wayne Tank & Pump Company Limited, Bracknell; Two diesel electric rail travelling cranes, Dyce and Irvine, from Taylor & Hubbard Limited, Leicester.

By agreement with Petroleos Mexicanos (PEMEX), the newly formed subsidiary of the Council of British Manufacturers of Petroleum Equipment—British Oil Equipment Credits Limited—is to supply equipment in connexion with the new extension to the Minatitlan refinery in Mexico to the value of £3½ m.

Order for three P612 water coolers through G. N. Haden & Sons Limited, heating engineers of London, for the new Turkish Parliament building in Ankara.

WILLIAM JONES LIMITED manufacturers of railway and civil engineering plant, London W1. Track layout 325 ft long for Auckland, commissioned by New Zealand Railways.

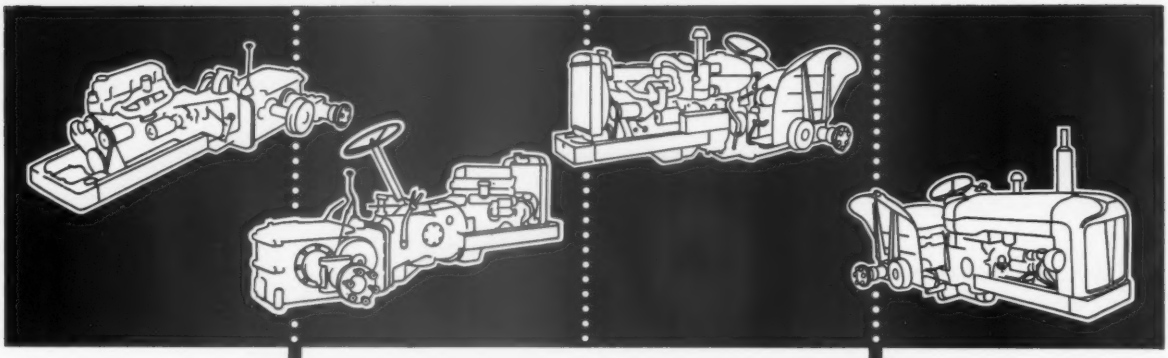
STANDARD TELEPHONES & CABLES LIMITED, London.—Order for 92 submerged two-way repeaters and 11 submerged equalizers of British design placed by Cable & Wireless Limited for the trans-Atlantic section of the Commonwealth round-the-world telephone cable, at a cost of about £1,800,000.

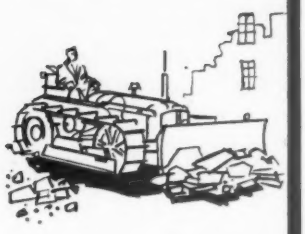
Armstrong Patents Half Century

FIFTY years ago Mr. Gordon Armstrong opened a small workshop in Beverley, East Yorks. The Armstrong factory at Beverley today employs 2000 people. In addition there are now factories in Canada and Australia, and a second factory in this country was opened at York and a special development establishment at Fulford. The Armstrong range of shock absorbers for the motor industry hardly needs mention here, but it may not be so widely known that amongst additional products produced by Armstrong Patents Company Limited—each one of which, by the way, bears the founder's name, there is the Heli-Coil—a stainless steel screw thread insert with wide application throughout the whole range of engineering and manufacture; and a hydraulic remote control of interest to building and industry generally. The company's shock absorber activity has been extended into the railway field.

Triplex Long Service Awards

A new long-service award for employees of the Triplex group of Companies was recently announced by Sir Graham Cunningham, chairman of Triplex Holdings Limited and chairman and managing director of the Triplex Safety Glass Company Limited. In future employees will receive a gift of their own choosing when they complete 45 years' service with Triplex. The Board decided also to present to retiring employees a cheque for £1 for every 12 months' service over 25 years.

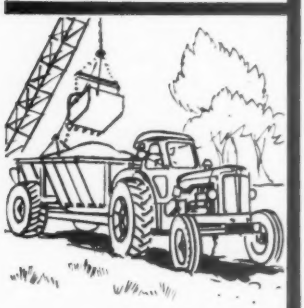




Buyers looking for better equipment look for

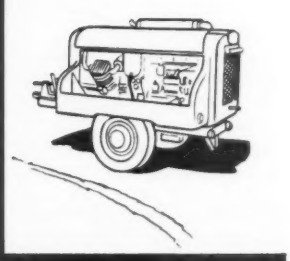
Fordson Power

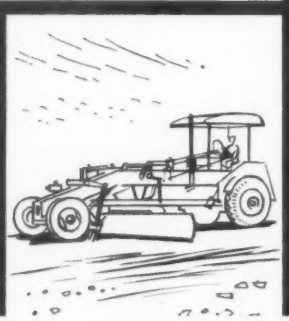
... because Fordson Power gives the stamp of reliability, ensures high output at low cost, and because it has the backing of the Ford world-wide service and spares organisation. There are Fordson Industrial Equipment Units in the 30-40 b.h.p. and 40-50 b.h.p. classes, in more than 100 different assemblies. Fit Fordson and you get all the benefits of quality mass production from Ford's famous Dagenham factory, the biggest producer of mobile power units. Fit Fordson, the unit tailor-made to your requirements.



Wise buyers insist on

Fordson Power





INDUSTRIAL SALES DEPARTMENT · TRACTOR DIVISION FORD MOTOR COMPANY LIMITED · DAGENHAM · ESSEX

Price Reductions

WESTINGHOUSE BRAKE & SIGNAL COMPANY Limited recently announced readjustments in the prices of their range of Germanium power rectifier units resulting in reductions of up to 33% on some types.

Navy Chief's Titles

THE old Navy titles of Engineer-in-Chief of the Fleet, Director of the Naval Electrical Department and Director General Supply and Secretariat Branch, have been replaced by Chief Naval Engineer Officer, Chief Naval Electrical Officer and Chief Supply and Secretariat Officer. These titles avoid anomalies which have arisen as a result of the reorganization of the material and personnel departments of the Admiralty and reflect the duties of the holders to advise on major matters of personnel policy affecting their specializations. Actually, these posts are held by officers serving in Admiralty in other capacities.

Trade with Egypt

FOLLOWING conclusion of the financial agreement between the United Kingdom and Egypt, the Export Credits Guarantee Department has now established adequate sources of status information on Egyptian buyers, and is resuming cover for trade with Egypt forthwith.

F.J.E. Hire Plan

A MACHINE hire plan requiring no deposit or capital expenditure has been instituted by F. J. Edwards Limited, machine tool makers. Under the F.J.E. plan the machine is delivered on the signing of the contract and on payment of the first monthly hire charge. Minimum period of rental is three years. An explanatory leaflet may be obtained from the company at 359 Euston Road, London NW1.

Import Certificates

RESPONSIBILITY for the issue of import certificates has been transferred from the Board of Trade Import Licensing Branch to the Export Licensing Branch at Gavrelle House, 2 Bunhill Row, London E.C.1.

Premier Industrial Safety Award

THE ROYAL SOCIETY FOR THE PREVENTION of Accidents announces that the Sir George Earle Trophy—the Blue Ribbon of the British industrial safety movement—has been awarded this year to Vauxhall Motors Limited.

Trade Literature

Ball and Roller Bearing Catalogue

Some impression of the vast range of ball and roller bearings manufactured by Ransome & Marles Bearing Company Limited, Newark-on-Trent, is conveyed in the 128 page catalogue recently issued. Thumb indexed for easy reference its contents cover rigid ball, self aligning, and adaptor sleeve bearings, magnets, needle roller, ball bushings and thrust bearings. An important section of the catalogue is the general technical information given to aid correct selection and mounting.

Dial Gauges and Measuring Instruments

The ninth edition of the Baty dial gauge and measuring instrument catalogue is now available from J. E. Baty & Co. Limited, Burgess Hill, Sussex. Its contents include full details of construction, the types of dial graduations and accessories, their well known range together with details of cylinder gauges, small bore gauges, comparators and thread measuring equipment.

Hobbing Small Gears

The Dowding V4 universal gear hobbing machine has been developed for the production of clock, meter and similar small gears used in the light engineering industries. An optional feature of the V4 which is described in a brochure from Dowding & Doll Limited, 346 Kensington High Street, London W14, is the cam operated automatic plunge feed which provides fast approach and automatic return of the work table for loading and unloading. This feature also permits precise control of the depth of cut for repetition production of worm wheels and spurs of narrow face width.

Rubber Coated Concrete Floors

Glocrete SR, a synthetic rubber based floor coating, has been developed by Corrosion Limited, Southampton to minimize the risk of infection arising from unsealed concrete floors in factories and warehouses. The coating which is washable and durable contains a strong germicide. Full details are given in the maker's leaflet.

Safety Guard Catalogue

A pocket size edition catalogue of Cleervue machinery safety guards is now freely available from The Silvaflame Company Limited, 218a Monument Road, Birmingham 16. Effective guards are shown for bench and pedestal drills, millers, lathes and tool grinders.

Improved Portable Power Saw

A number of modifications and improvements have been embodied in the latest Kennedy portable power hacksaw, the Mark II of 2⅜ in. capacity. These include a thermal-overload control for the ½ hp motor, a calibrated vice jaw and zero cutting edge for easy positioning. Full details of the machine are given in a leaflet issued by W. Kennedy Limited, West Drayton Middx.

Catalogue of Lighting Fittings

Some idea of the great variety of modern lighting schemes which can be put into effect is conveyed in the 80 pages of the Courtney, Pope, catalogue of lighting fittings. Its contents are divided into sections covering fluorescent fittings, special ceilings, neon lighting and tungsten fittings of contemporary design. Copies are available from Courtney, Pope (Electrical) Limited, Amhurst Park Works, Tottenham, London, N15.

Steel Foundry Service

Details of the service and facilities available at The North British Steel Foundry Ltd., Bathgate, Scotland, are given in their new 28-page booklet. In addition it contains useful notes on the use of steel castings and steels generally. In the reference section, the mechanical properties, chemical test requirements and equivalent specifications are given for 31 steels, together with short descriptions of their individual properties and applications.

Solartron Review

A handsome brochure in full colour has been issued by The Solartron Electronic Group Limited, Thames Ditton, Surrey, to mark the completion of their first decade. The original two-man nucleus is now expanded to a group board of experts which controls six specialised subsidiary companies, each having a complement of scientists, engineers and technicians. Overseas there are now four sales subsidiaries and a further five Solartron associate companies. Sales of the 125 Solartron items of proprietary equipment have topped the £2,000,000 per annum mark, to a wide range of customers, with exports running at £500,000 per annum.

Turbine Flowmeters

Technical bulletin No. 1384 from Cox Instruments Division, George L. Nankervis Company, 15300 Fullerton Avenue, Detroit 27, Michigan, describes a new line of Cox Type 20 turbine flowmeters for measuring the flow of jet fuel, petrol, oil, water, acid and alkali chemicals and other liquids. The bulletin gives specifications and information on operation, accuracy, serviceability, high-temperatures, high pressures, installation and signal outputs.

Blyth. Central Electricity Generating Board. The contract for foundations and civil engineering work for the new "B" power station being built at Blyth has been let to Sir R. McAlpine and Sons, Jesmond Road, Newcastle upon Tyne.

Boldon. Durham Coal Board. Plans are being prepared for the erection of central workshops of 67,000 sq ft at Whitburn Colliery by the N.C.B. Architects' Dept., 24 The Side, Newcastle upon Tyne.

Carlisle. Initial Services Limited. The contract for the erection of a laundry on the Durranhill Estate has been let to John Laing and Sons, Dalston Road. The architect is S. A. S. Yeo, 3 Chesham House, Willesden Green Estate, London NW2.

Mr. Fontana. Plans for an ice cream factory, frozen food store and garage in King Street have been prepared by A. F. Sewell, 28 Lowther Street.

Chester-le-Street. Caterpillar Tractor Company. The Rural Council has approved plans for the fifth stage of a factory extension scheme.

Cumberland. The County Council's scheme for new highways depot at Dalston is out to tender. Plans by J. H. Haughan, County Architect, 15 Portland Square, Carlisle.

Darlington. Tallent Limited. The contract for factory additions at Aycliffe has been let to D. and J. Ranken Limited, Stockton Road, Sunderland. The architects are Fennell and Baddiley, Bridge End Chambers, Chester-le-Street.

B.R.S. (Pickfords) Limited, 102 Blackstock Road, London N4, are to build a furniture warehouse in Haughton Road, Darlington and have prepared outline plans.

C. G. S. Buist Limited. Garage and showrooms extensions. Architects: Cackett, Burns, Dick and McKellar, 21 Ellison Place, Newcastle upon Tyne.

Sherwood Brothers are to erect garage, showrooms, etc., to plans by J. G. L. Poulson, 54 Albert Road, Middlesbrough.

Hebburn. Baker Perkins Limited, are fo erect an office block at their Bedewell Works. The contractors are Bewley and Scott, Dunston-on-Tyne.

Houghton-le-Spring. Durham Divisional Coal Board are to erect central stores, boilerhouse and garage unit at Lambton Engine Works; plans by the N.C.B. Architects' Dept., 24 The Side, Newcastle upon Tyne.

Messrs. G. Burnside. Plans for factory alterations at Shiney Row are being prepared by Newrick and Blackbell, 58 John Street, Sunderland.

Middlesbrough. Fentiman's Direct Supply Limited. Mineral water factory. Architect, E. W. Chapman, 125 Acklam Road, Thornaby-on-Tees.

British Railways. Preliminary operations have started in connexion with a £3,750,000 marshalling yard at Newport, near Middlesbrough. Earth works by Taylors Limited, West Road, Crook; Brims and Co. Limited, City Road, Newcastle upon Tyne are constructing steel sheet piling at Stainsby Beck; and Girling Ferro-Concrete Company Limited, Leeds, are constructing concrete bridge beams over the Beck.

W. Richards and Sons Limited, iron manufacturers, Britannia Foundry, North Ormesby Road, have acquired adjoining premises for works developments.

Newcastle upon Tyne. Yorkshire Imperial Metals Limited. Offices and warehouse in Elswick Road. Plans are being prepared by Cackett, Burns, Dick and McKellar, 21 Ellison Place.

Scarborough. Tesseymans of Scarborough Limited. Proposed spring factory in Seamer Road. Architect, E. Allen, 32 St. Nicholas Street.

South Shields. S. Newman Limited. Work has started on factory additions. The builders are J. Cummings, Matamba Terrace, Sunderland. Architects, Jack Cotton, Ballard and Blow, Haymarket House, Newcastle upon Tyne.

Elsy and Gibbons Limited. Plans have been approved for factory and offices on Simonside Estate. The architects are Page, Son and Hill, 75 King Street, South Shields.

John Readhead and Sons are buying land for extending their shipyard.

New Factories

Campbell and Isherwood Limited, electrical engineers, Silver Street, Newcastle upon Tyne, propose new premises in Commercial Road.

Prices Tailors Limited. The tender of R. Jordan Limited, Back Queen Alexandra Road, North Shields, has been accepted for factory extensions in Adelaide Street. The architects are W. H. Williamson and Partners, 7 St. Mary's Place, Newcastle upon Tyne.

Stockton-on-Tees. S.P.D. Limited, transport distributors, Thistle Green, are to build a new cold store and office accommodation near Portrack Lane.

H. B. Raylor and Co. Limited, Thomas Street Works, York, are to erect warehouse and office block at Haverton Hill Road, and are discussing the scheme with the local planning authorities.

Sunderland. The C.W.S. Limited, Newcastle upon Tyne, are to build a distribution depot on a site of 8000 sq ft in East Cross Street.

Tynemouth. The Town Council has received an inquiry from a firm seeking a site for making sports cars.

Associated Lead Manufacturers Limited, Crescent House, Newcastle upon Tyne are to build a four-bay storage shed at their Hayhole Lead Works, and plans have been approved. The firm have their own architect.

Birmingham. Rootes Motor Parts Limited are to extend their factory at Coventry Road. The architects are Hurley Robinson & Partners, Birmingham.

Bishopton. Royal Gunpowder Factory. Extensions proposed.

Blackburn. General Post Office. A new engineering depot is to be erected in Grimshaw Park district.

Bletchley. The Urban Council is to make extensions to Factory No. 4, on their No. 1 industrial estate.

Chelmsford. S.P.D. Limited, Green Bank, Wapping, London E1. New premises on the Widford industrial estate. Consulting engineers are Frederick S. Snow & Partners, Monro Building, Wellington Street, London WC2.

Cheltenham. Douglas Equipment Limited. Factory extensions. The architects are L. W. Barnard & Partners, 13 Imperial Square.

Chessington. Mence & Moore, 24 Cranbourne Street, London WC2 have prepared plans for a new factory at Roebuck Road.

Coventry. Mobil Oil Company Limited are to make extensions to their premises on the Torrington Avenue industrial estate.

Dagenham. Warton Fillings Limited. Extensions to the factory at Roebuck Road, Hainault Estate.

Elgin. Scottish Malt Distillers Limited. Plans have been approved for the erection of a new building at Borough Briggs.

Glasgow. Associated Metal Works Limited, 30 St. Andrews Square. Works extensions. Architects, Wilson, Hamilton & Wilson, 5 Woodside Terrace, Glasgow C3.

Guildford. Surrey Advertiser & County Times Limited. Extensions are to be made to the works and offices.

Heanor. I. & R. Morley Limited are to modernize their dyeing and finishing works.

Heywood. Silvester Litton Limited, Roeacre Tannery. Tannery extensions.

High Wycombe. Assigned Basic Chemicals Limited, Newlands Meadow. New building Thurlow, Lucas & Janes, 86 Easton Street, are the architects.

Hounslow. Perrett Controls Limited. New works at Green Lane. The contractors are E. H. Burgess Limited, Great West Road, Brentford.

Isle of Wight. An application has been made to use Wippingham Gun site, East Cowes, for a light industrial estate.

Invergordon. William Grigor and Son Limited, are ac ively concerned in the scheme for a £400,000 distillery which is being financed by the Aberforth Property Investment Company, Aberdeen. The Grigor Group already own a number of distilling and bonding units and with this distillery will become a completely self contained group.

Leicester. Machine Components Limited, 90 Curzon Street. New factory to be erected at Victoria Road East.

Willis Engineering Company Limited, 108 New Walk. New factory to be erected at Victoria Road East.

London. City Industrial Limited. A new factory is to be built in Farringdon Road.

Cannon Rubber Manufacturers Limited, Ashley Road, London N17, are to erect a new factory at High Road.

Lytham St. Annes. Holt Jackson Book Company Limited, Preston Road. Works extensions.

Manchester. Fielden Electronics Limited. Extensions are to be made to the factory at Paston Road.

Merthyr Tydfil. Hoover (Washing Machines) Limited, Pentrebach. Works extensions. Architects, Wallis Gilbert & Partners, 5 Cromwell Road, London SW7.

Northern Ireland. Martin-Baker Aircraft Company Limited has acquired Langford Lodge Airfield from the Air Ministry for the manufacture there of ejector seats for high speed aircraft. Cyril Lord Carpets Limited have been allocated a second new advance factory of 73,000 sq ft on the Carmoney estate, Belfast Lough.

Norwich. Roneo Limited, Romford. The contract for the erection of a new factory at Salhouse Road, Sprowton, has been let to A. E. Symes Limited, 236 High Street, Stratford, London E15.

Pembrey. Bristol Aerojet Limited have been granted an industrial development certificate for the expansion of rocket motor works at the former airfield.

Plymouth. Fisons Limited. The contractors for the new factory and offices are James Miller & Partners Limited, Hayes.

Romford. Hainault Upholstery Limited, Tonbridge Road, Harold Hill, are to make extensions to their factory.

St. Albans. Electrolux Limited, Luton. New factory in Valley Road. Kyle Stewart (Contractors) Limited, Ardshiel House, Empire Way, Wembley, have received the contract.

Thetford. The Town Council is to carry on with plans for the erection of two factories.

Wakefield. J. C. Caddies (Knitwear) Limited, Victoria Works, Benjamin Street. Factory extensions.

Watford. Sun Printers Limited, Whippendell Road. Extensions to works.

CLASSIFIED ADVERTISEMENTS

Situations Vacant

DRAUGHTSMEN

Experienced in the design of compressors or pumps, required by well-established and progressive company situated in the Midlands. Good salary paid to suitable applicants. Apply Box No. 1W 20, "Mechanical World", 31 King Street West, Manchester 3.

Machinery, Plant and Accessories For Sale

NEW ¾" GUILLOTINE for sale. EX STOCK. Motorised Overcrank type. Cutting width 8′ 4⅜". Auto hold-down and all necessary gauges. Depth of gap in open ends 9¾". Weight 17¾ tons. Photo etc., from F. J. Edwards Limited, 359, Euston Road, London, NW1, or 41, Water Street, Birmingham 3.

10FT × ¾ in. CRAIG & DONALD PRESS BRAKE for sale. Pressure 400 tons. All steel construction. Model 400/10. Motorised with 50 h.p. motor suitable for 400/3/50. F. J. Edwards Limited, 359 Euston Road, London, NW1. Euston 4681 or 41, Water Street, Birmingham 3, Central 7606.

"FRIGIDAIRE" Low Temperature Refrigerators. 49 in.w × 28 in.d × 34 in.h ext. Ex Large National User, suitable A.C. or D.C. Deep Freezing, Storage of Ice Cream, Frozen Foods, etc. Price £40.0.0 each. Domestic Refrigerators, Service Cabinets and Cold Rooms also available. A.R.C., 134 Great Portland Street, London W1. MUSeum 4480.

FANS! ! ! for Dust, fume extraction, air conditioning, compressors, accessories, motors, etc.; at considerably reduced prices. People say—"If only we'd known of you before. . . . Write for very interesting list. Bellangers, 306 Holloway Road, London N7. North 4117.

PUMPS for all purposes. R. L. Christiansen Limited, Wordesley, Stourbridge. Brierley Hill 78184/5.

Patents For Sale or License

THE proprietor of British Patent No. 709099, entitled "MILLING MACHINE" offers same for licence or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 East Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 726738, entitled "Boring and Turning Machines", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 East Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 722922, entitled "Resilient Seal Gate Valves" offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Boulevard, Chicago 4, Illinois, U.S.A.

Classified advertisements are inserted at the rate of 2/9 per line.

THE proprietor of British Patent No. 724299, entitled "Dampener for differential pressure indicators", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 684356, entitled "Machine and method for stripping hop vines" offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 630142, entitled "METHOD AND APPARATUS FOR DISTILLING CARBONACEOUS MATERIAL", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 726707, entitled "ATOMIZING SPRAYER", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

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